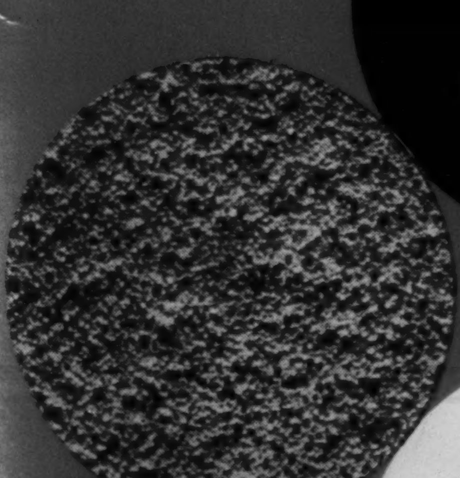
Materials & Methods

Selection & use of

metals, nonmetallics, parts, finishes,

in product design & manufacture

PLASTICS SHOW PREVIEW



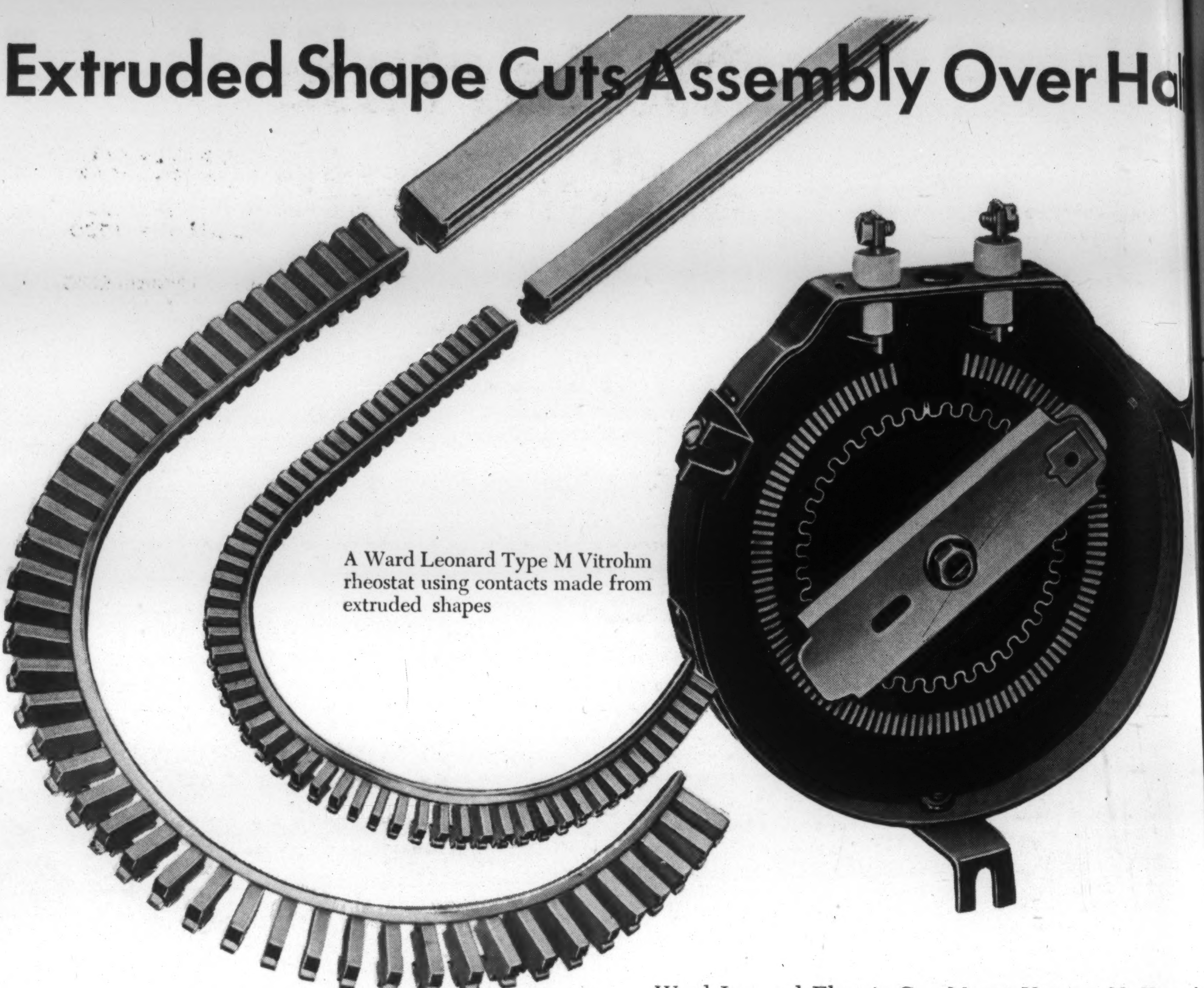
FOAM PLASTICS MANUAL

PLASTICS PROGRESS

OTHER FEATURES:
HEAT TREATING TITANIUM
NEW PHOTOSENSITIVE GLASS
TITANATE COATINGS
COMPLETE CONTENTS PAGE 1

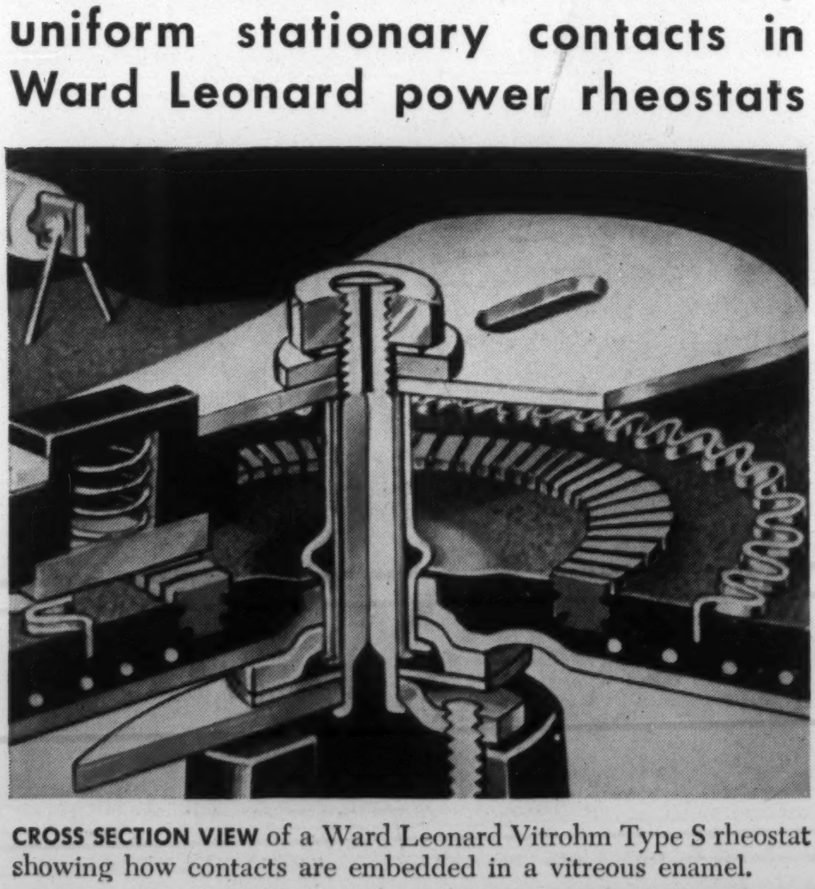
966

Extruded Shape Cuts Assembly Over Ha



A Ward Leonard Type M Vitrohm rheostat using contacts made from extruded shapes

Ingenious application eliminates hand assembly, makes absolutely uniform stationary contacts in Ward Leonard power rheostats



CROSS SECTION VIEW of a Ward Leonard Vitrohm Type S rheostat showing how contacts are embedded in a vitreous enamel.

Ward Leonard Electric Co., Mount Vernon, N. Y., makes a line of high quality power rheostats marketed under the trade-name Vitrohm. Anywhere from 41 to 161 individual stationary contacts, or buttons, have to be embedded with their resistance elements in an insulating vitreous enamel—all contacts uniformly set and spaced, for uniform performance. Their patented process originally used buttons blanked out of sheet brass—hand assembled and spaced on a steel wire to hold them while the vitreous enamel was fired.

Ward Leonard refined the process and for four models now starts with the extruded shapes shown above. The stock is accurately slotted for correct spacing, forming a continuous line of buttons connected by a triangular "wire"—which is an integral part of the extruded shape. When sections are curved, the buttons remain uniformly spaced and oriented. After the button assemblies are embedded in the vitreous enamel, the connecting wire is easily milled off. Ward Leonard gets absolute uniformity with less effort and fewer rejects—it gets healthy dollar savings, despite the fact that more than half of the extruded shape is milled out.

Imagination applied to extruded shapes can pay big dividends—lower direct labor costs—fewer machining operations—less scrap—improved product quality. Your Anaconda representative will be glad to work with you. The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

5584

ANACONDA®

EXTRUDED SHAPES

Short cuts to a finished product

For more information, turn to Reader Service Card, Circle No. 377

Materials & Methods®

UNIVERSITY
OF MICHIGAN
JUN 6 - 1956
EAST ENGINEERING
LIBRARY

Selection & use of

metals, nonmetallics, parts, finishes

in product design & manufacture

JUNE 1956 VOL. 43, NO. 6

PLASTICS SHOW PREVIEW 17
Registration Information. Technical Program. List of Exhibitors

FEATURE ARTICLES

Progress in Plastics .... *M. W. Riley* 112
A review of the new materials, uses and design data developed during the past two years

New Titanate Coatings .... *R. J. Fabian* 120
Aluminum-pigmented paints based on a titanium ester withstand temperatures of 1100 F

Aluminum Chain .... *H. F. Reid, Jr.* 124
Welded and weldless types should be useful where light weight or corrosion resistance are important

How to Heat Treat Titanium .... *W. Finlay, W. Wentz, D. Kaufmann* 126
How to take fullest advantage of titanium's inherent strength by means of quench-age heat treating cycles

Boride Parts Resist Molten Zinc .... *R. M. Evans* 132
Made by powder metallurgy techniques, iron-boron parts may be the answer to an old corrosion problem

Chemical Machining of Photosensitive Glass .... *M. Byer* 134
Fotoform process eliminates costly machining methods, makes possible new patterns in glass

Redesigning for Malleable Iron .... *D. Fulton, J. Entenmann, T. Kirby* 140
Case histories show how malleable can replace other materials where toughness or low cost are needed

Materials at Work 119, 123, 131, 138
Aluminum-Glass Walls. Materials Used in First U.S. Monorail. Glass Fabric Conveyor Belt. Expanded Metal Cable Trough

MATERIALS & METHODS MANUAL NO. 127

Foam Plastics .... *W. Brenner* 143

ENGINEERING FILE FACTS

Forgeable Metals and Forging Design 161

NEW MATERIALS PREVIEWS

220,000 Psi Steel Bolt 165

Semi-Annual Index to Feature Material, Vol. 43 297

DEPARTMENTS

Materials Outlook 3
Materials Briefs 7
Men of Materials 9
Materials Engineering News 11
Letters to the Editor 14
Reader Service 71
Manufacturers' Literature 72
One Point of View 111
Other New Materials, Products 169
Contents Noted 207
Engineers, Companies, Societies 250
Meetings & Expositions 260
Advertisers and Their Agencies 300
The Last Word 302

COVER DESIGN: HARRY & MARION ZELENKO

PRICE 50 CENTS A COPY, PAYABLE IN ADVANCE, ONE YEAR, $2.00; TWO YEARS, $3.00 IN U. S., POSSESSIONS AND CANADA. IN ALL LATIN AMERICAN COUNTRIES: ONE YEAR, $10.00; TWO YEARS, $16.00. ALL OTHER COUNTRIES: ONE YEAR, $15.00; TWO YEARS, $25.00 (REMIT BY NEW YORK DRAFT). COPYRIGHT, 1956, BY REINHOLD PUBLISHING CORPORATION, NEW YORK, N. Y. PRINTED BY PUBLISHERS PRINTING CO. SECOND CLASS MAIL PRIVILEGE AUTHORIZED AT NEW YORK, N. Y. ADDITIONAL ENTRY AT BROOKLYN, N. Y. ESTABLISHED IN 1929 AS METALS AND ALLOYS.

WILLIAM P. WINSOR
Publisher

H. R. CLAUSER
Editor

JOHN B. CAMPBELL
Managing Editor
JOHN L. EVERHART
Technical Editor
R. J. FABIAN
Associate Editor
MALCOLM W. RILEY
Associate Editor
EDWIN M. WEISS
Associate Editor
SCOTT W. CONKLING
Assistant Editor
GIL MILLER
Art Director
PENNY DREXLER
Editorial Assistant

M. RANDOLPH LONG
Advertising Sales Manager
FRANK J. ARMEIT
Production Manager
GLORIA de LATTAIGNANT
Asst. Production Manager
JOHN Y. CUNNINGHAM
Promotion Manager
JOHN N. CARLIN
Circulation Manager
E. M. WOLFE
Manager, Reader Service

Published monthly by
REINHOLD PUBLISHING CORP.
430 Park Avenue
New York 22, N. Y.

RALPH REINHOLD
Chairman of the Board
PHILIP H. HUBBARD
President & Treasurer
K. A. STARKE
Assistant Treasurer
F. P. PETERS
Vice President & Secretary
A. E. FOUNTAIN
Vice President
H. BURTON LOWE
Vice President
MERALD LUE
Vice President
D. BRAD WILKIN
Vice President
WILLIAM P. WINSOR
Vice President

Materials & Methods is indexed regularly in the Engineering Index and the Industrial Arts Index

NOW...
heat treat under high vacuum at temperatures up to 2000°F ...in gas-tight Inconel retorts

Bright annealing such active metals as titanium or zirconium is easy, today. So is no-flux brazing of stainless steels.

New, high vacuum furnaces do away with the atmospheric impurities that once made such operations difficult. What's more, they can even de-gas the metals themselves.

High Vacuum Equipment Corp. (349 Lincoln St., Hingham, Mass.) makes the new units . . . turning out a wide variety of shapes and sizes for work loads of a few pounds to several tons.

Inconel* keeps retorts *gas-tight*

According to the builders, proper operation of these high vacuum furnaces calls for gas-tight retorts. They must be so nonporous that it would take 120 years for a thimbleful of air at atmospheric pressure to leak in.

They must *stay* gas-tight, too . . . and keep shape despite pressure . . . despite temperatures to 2000°F . . . despite the tremendous thermal shocks of water-spray cooling . . . despite oxidation, carburization and other forms of attack.

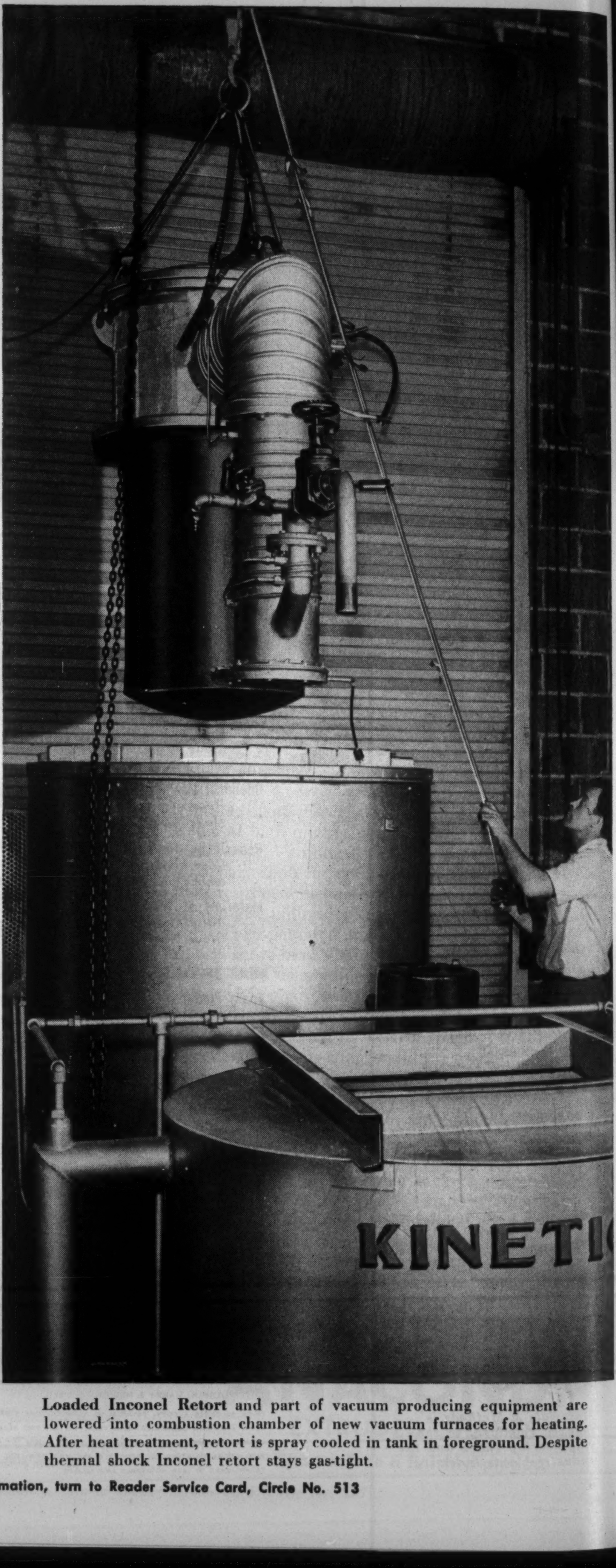
Inconel nickel-chromium alloy is able to handle such an assignment. It has given as much as 5000 hours in these high vacuum retorts without sign of failure.

You may be looking for an alloy like this . . . with high and lasting hot strength plus corrosion resistance. If so, look into Inconel. A new Inco booklet, "Keep Operating Costs Down When Temperatures Go Up", pictures many ways to use Inconel effectively. Write for a copy.

*Registered Trademark

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N.Y.

INCO TRADE MARK **Inconel**
...for long life at high temperatures



Loaded Inconel Retort and part of vacuum producing equipment are lowered into combustion chamber of new vacuum furnaces for heating. After heat treatment, retort is spray cooled in tank in foreground. Despite thermal shock Inconel retort stays gas-tight.

For more information, turn to Reader Service Card, Circle No. 513

Materials Outlook

A URETHANE ELASTOMER is now commercially available in this country. The diisocyanate-polyester elastomer features high tensile strength and good abrasion resistance and aging characteristics, as well as resistance to high ozone concentrations, oil and jet fuels, and irradiation. The elastomer is being custom formed by liquid casting and by injection or compression molding. Its properties make it a likely material for hydraulic applications, particularly for sealing and where abrasion resistance is important.

PRICE OF PRIMARY MAGNESIUM and magnesium products has gone up. The increases bring the price of primary pig to 33¾¢ per lb and primary ingot to 34½¢ per lb, f.o.b. Velasco, Tex. Price of AZ91B die casting alloy was upped 4¢ per lb and most other alloys 3¼¢ per lb. Anodes were boosted 3½¢ per lb. Magnesium mill products, including sheet and extrusions, were increased about 10%.

UNIFORMITY IN VACUUM MELTED ALLOYS is claimed by one of the newest producers, a supplier of specialized alloys for investment casting. On the assumption that batch variations are inevitable when the charge composition varies widely, this company employs vacuum melting only as a remelting step after first air melting to remove most of the gases in the charge metal. Good reproducibility of properties has been achieved, and cost of the initial air melting is offset by a reduction of 25% or more in time needed for the more expensive vacuum melting.

MATCHED-DIE MOLDING of reinforced plastics is improved by a new method which: 1) reduces costs by unique mold construction — one die is stainless sheet backed with rubber and a metal-filled plastic, and the other is a plastic reinforced with structural steel; 2) achieves good surfaces on molded parts by controlling closely the temperature of the stainless steel face, which is heated by electrical resistance; 3) insures uniform distribution of the glass reinforcement by a novel preforming operation; and 4) eliminates voids by applying vacuum to the mold cavity during closure.

BRASS COATINGS ON COSTUME JEWELRY and door knobs can be shiny and long wearing. Additions of sodium orthoaminobenzoate and sodium phenylxanthate to the plating bath have resulted in brass deposits that remain bright up to 0.001 in. The method also cuts plating time by 10%.

RIGID ISOCYANATE FOAM can be used for pipe insulation. Foam insulation is applied by pouring foaming liquid into a form made by securing Mylar film around the pipe to be insulated. After foaming is completed, the Mylar form is stripped away leaving an insulation jacket around the pipe.

Materials Outlook

FUTURE SUPPLY OF ZIRCONIUM for atomic reactors will be provided by new plants now being constructed. Stimulus for expanded production facilities was provided by Atomic Energy Commission contracts calling for the delivery of 11 million pounds of the metal over a five year period at a total cost of $75 million. National Distillers Products Corp. is scheduled to supply 1,000,000 lb of zirconium annually; National Research Corp., 700,000 lb; and Carborundum Co., 825,000 lb. National Research reported its price on zirconium as $6.50 per lb.

A MODIFIED ACRYLIC FIBER to be available in commercial quantities this fall is reported to be more fire resistant than any other fibers except glass and asbestos. In addition to the other favorable properties of acrylic fibers, the new material has double the moisture regain of existing acrylics.

COPPER STRIP 0.00025 in. thick is now in commercial production. The strip, 1/12 the thickness of a human hair, can be supplied in widths from ½ to 5 in. and in tolerances as close as ±0.00005 in. The ultra-thin metal permits designing of miniaturized transformers by substituting tape-wound wafer-type coils for the bulkier coils made of magnet wire.

VULCANIZING SILICONE RUBBER by high energy radiation, under study for several years, appears to be getting closer to commercial reality. A large electrical manufacturer has announced details of an experimental process which utilizes two-million-volt electrons to produce a better rubber in 2 sec than conventional methods yield in several hours. Degree of vulcanization is controlled by regulating voltage and exposure time.

A NEW INVESTMENT CASTING METHOD: Blemish-free castings with surface finshes of 20 to 40 microin. are possible with a new investment process. Molds are built up by repeatedly dipping wax patterns into a slurry of silica glass powder. The assembly is then fired at 2200 F, producing a mold with walls ⅛ to ¼ in. thick. Molds can withstand pouring temperatures up to 3300 F.

CORROSION OF METALS in aqueous systems at elevated temperatures and pressures can be measured by a newly developed hydrogen effusion method. This method measures the amount of hydrogen given off during the corrosion reaction, which in turn is a measure of the rate of metal corrosion.

OUTPUT OF PRIMARY COPPER established a new record in 1955. World smelter production rose to 3,325,000 tons, an increase of 9% over 1954. This country accounted for one-third of the world's total. Approximately 90% of the copper smelted in the U.S. came from domestic ores.

Materials BRIEFS

Umbroiler

Aluminized plastic has been used to make a folding solar cooker that looks like an umbrella. The device collects the sun's rays and concentrates them on a grill. Sunshine is the only fuel required for cooking.

Home Grown Rocks

Diamonds are now being successfully produced in a pilot plant operation. If the cost of man-made diamonds can be brought down below the cost of those mined, man-made diamonds could become a $200 million annual business.

Moderation Wins

Colored laminated plastics are bought by Americans in this order: gray, 29%; red and pink, 22%; yellow, 17%; and green, 13%. Red is falling in demand while pink is making the largest gain.

Coffee Break

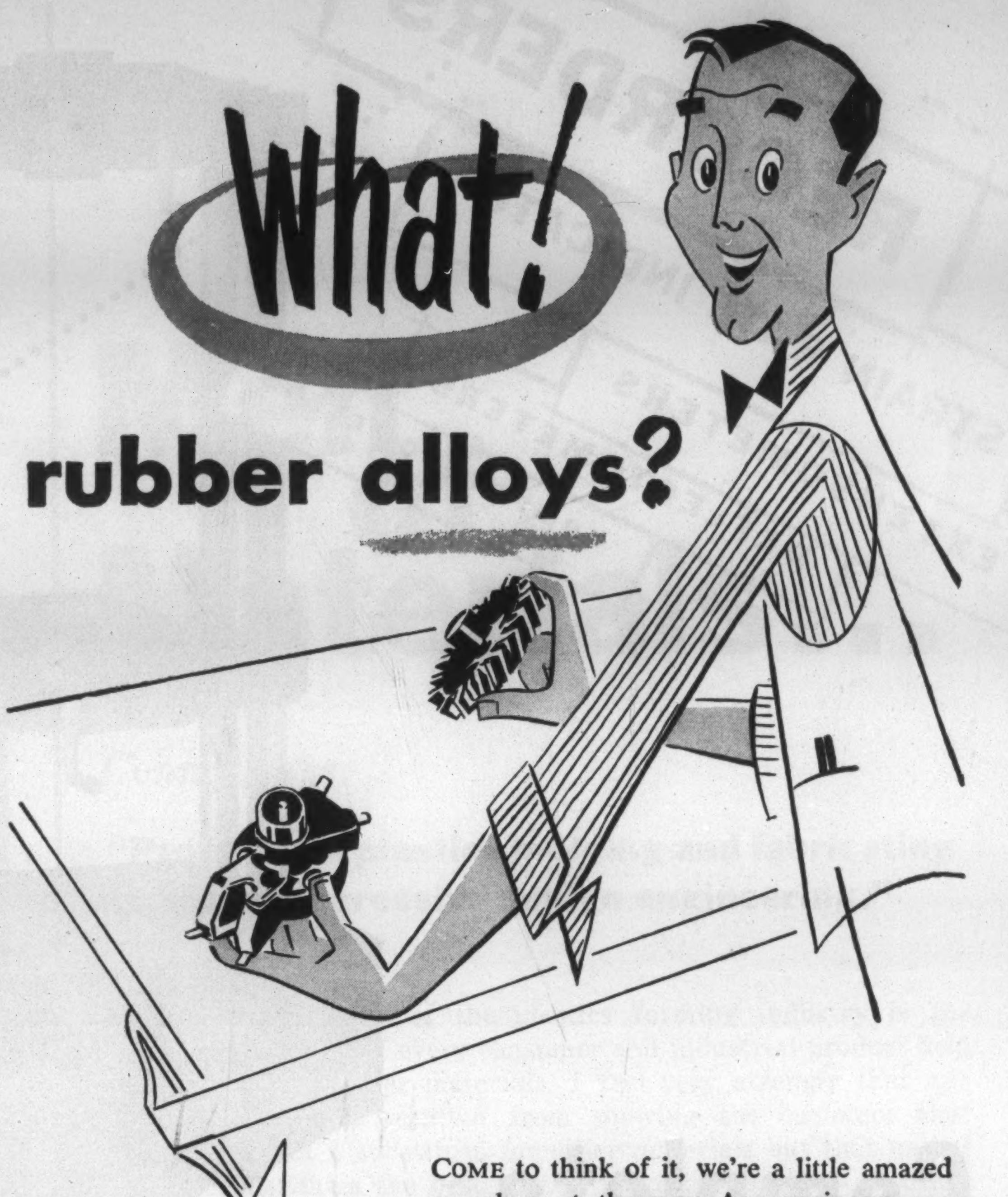
Efficiency of electrodeposition in a zinc cyanide plating bath is greatly increased by the addition of a small amount of coffee. The presence of coffee is claimed to result in gleaming silvery zinc deposits.

Synthetic Wonderland

Plastics shavings or scrap, celluloid flakes, mica or fiberglass sprinkled on a layer of raw cotton results in a snow that permits a skier to execute all movements that are possible on the real thing.

Rain Check

Compounded of silicones and wax, a rain repellent for windshields makes water behave like heavy beads of mercury. The repellent eliminates the need for a mechanical windshield wiper on high speed aircraft.


What!
rubber alloys?

COME to think of it, we're a little amazed ourselves at the way Ace engineers can blend the mechanical, electrical and chemical properties of different rubber and plastic materials. Their aim is always to find the one best material for each of your jobs . . . never *over*designed . . . with production economy a must. Result: hundreds of tailor-made rubber, plastic, and rubber-plastic alloys to choose from . . . plus many unusual materials like Ace-Tex pyrobitumens. Ask us for anything from rough-ground rods to finished molded assemblies. Our facilities for molding, extruding, fabricating, and lining are among the world's largest.

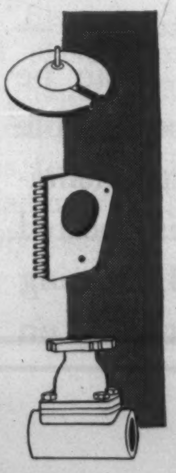
ACE®

Controlled-property compounds meet your needs for:

MECHANICAL,

ELECTRICAL,

CHEMICAL APPLICATIONS



Always check your ACE design engineer's Handbook when selecting materials for today's production and tomorrow's plans. If you haven't a copy, write today! It's Free.

ACE
HANDBOOK

ACE rubber and plastic products

AMERICAN HARD RUBBER COMPANY
93 WORTH STREET • NEW YORK 13, N. Y.

For more information, turn to Reader Service Card, Circle No. 441

RECORDERS
STRAIN RATE INDICATOR
EXTENSOMETERS
DEFLECTOMETERS
COMPRESSOMETERS

Complete instrumentation!

Riehle-designed . . . Riehle-built

Riehle Universal Testing Machines—whether hydraulic or mechanical—can be equipped with the most modern and flexible autographic strain measuring instrumentation. The Riehle-built Recorder is located under the writing table of the Indicating Unit with its controls placed conveniently on the console. A complete family of recorder accessories is available—comprising various types of strain measuring instruments for magnification ratios up to 1000:1, strain rate indicator and time interval marker. Mail coupon for further information.

For more information, Circle No. 477

Riehle TESTING MACHINES
A DIVISION OF
American Machine and Metals, Inc.
EAST MOLINE, ILLINOIS

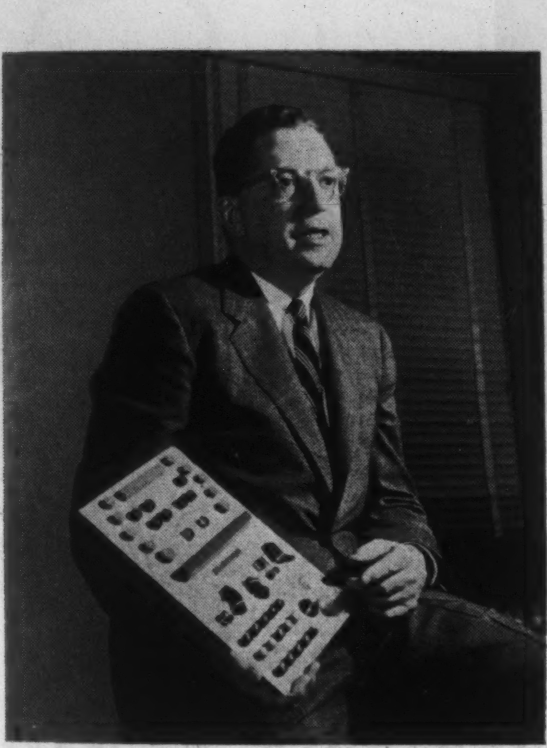
RIEHLE TESTING MACHINES
Division of American Machine and Metals, Inc.
Dept. MM-656, East Moline, Illinois

At no obligation, please furnish additional information:

☐ Send literature.
☐ Have a Riehle sales engineer call at first opportunity.

COMPANY
ADDRESS
CITY ZONE STATE

Men of Materials...



Walter J. A. Connor has broad experience in the manufacture and sale of plastics products. Currently executive vice president of American Plastics Corp., a subsidiary of Heyden Chemical Corp., Mr. Connor began his career with Celluloid Corp. Since then he has held executive positions with Manufacturers Chemical Corp., U. S. Fiber and Plastics Corp., Koppers Co., and Celluplastic Corp.

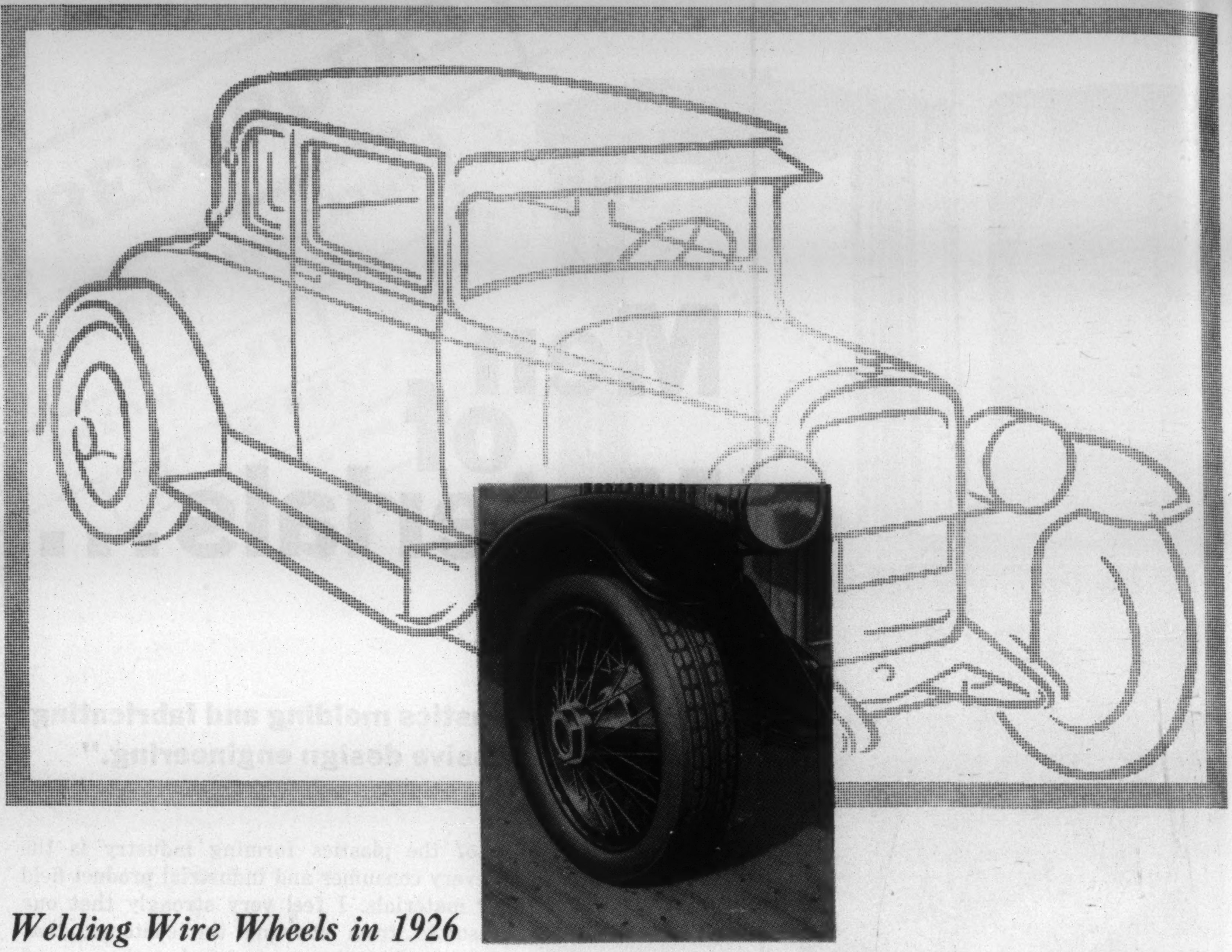
Connor says:

"Progress in plastics molding and fabricating is tied to aggressive design engineering."

"The avowed aim of the plastics forming industry is the continued invasion of every consumer and industrial product field now serviced by other materials. I feel very strongly that our gains so far have resulted from showing the customer that plastics are not a substitute for other materials but that use of plastics constitutes the best way to make his product—in other words, that it is a good application.

"What constitutes a good application for plastics can be determined only by knowing to what end use the product will be put and designing for that use. We are offering to the product manufacturer one of the most versatile group of materials ever made available—materials that respond to creative engineering and design applications. In fact the growth of the plastic forming industry is testimony that the job can usually be done better and cheaper with plastics.

"Because designs can frequently be produced in one of several plastics or processes, the plastics molding and fabricating industry has evolved into a highly competitive business. This adds up to better engineering service to the consumer. The plastics forming industry stands ready to furnish the product manufacturer with ideas and estimates on the most effective way to apply plastics to his particular problem or design."



Welding Wire Wheels in 1926

Helped MALLORY Learn Better Ways to Solve Your Welding Problems Today

THIRTY YEARS AGO, a leading auto manufacturer (still a leader today) ran into a serious production bottleneck in resistance welding of wire wheels. The copper dies being used wore out so quickly that costs were too high, production too slow.

Elkonite®, a material developed by Mallory, looked promising for this application. It was tried . . . and the results were excellent. Die life increased tenfold. And production was freed of stoppage troubles.

This development marked Mallory's entry into the resistance welding field. It has been followed, in succeeding years, by a continuous stream of contributions to welding technology. These are some of the major milestones in Mallory progress:

Specialized alloys, like Elkaloy® A, Mallory 3, Mallory 22 and many others, which provide a family of materials engineered for the specific needs of welding service.

Fluted electrodes, which greatly increase electrode life.

Cold forming methods for producing bent electrodes with greater hardness and strength.

Special holder designs to meet the needs for higher pressures for large welding machines, and low pressures for non-ferrous alloys.

The knowledge gained during three decades of pioneering activity and constant development stands ready to serve on your own resistance welding problems. Write or call Mallory for a personal consultation by a Mallory welding engineer . . . and see your local Mallory welding distributor for prompt delivery of the best in welding electrodes, holders, seam welding wheels, forgings and supplies.

In Canada, made and sold by Johnson Matthey & Mallory, Ltd., 110 Industry Street, Toronto 15, Ontario.

For information on titanium developments, contact Mallory-Sharon Titanium Corp., Niles, Ohio.

30 Years of Welding Progress

P R MALLORY & CO Inc

MALLORY

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

For more information, turn to Reader Service Card, Circle No. 480

MATERIALS ENGINEERING NEWS

This month

- ▶ *Zinc supply*
- ▶ *Dust erosion*
- ▶ *Rubber in cars*

Customer service provided by . . .

New Elastomers Laboratory for Research and Development

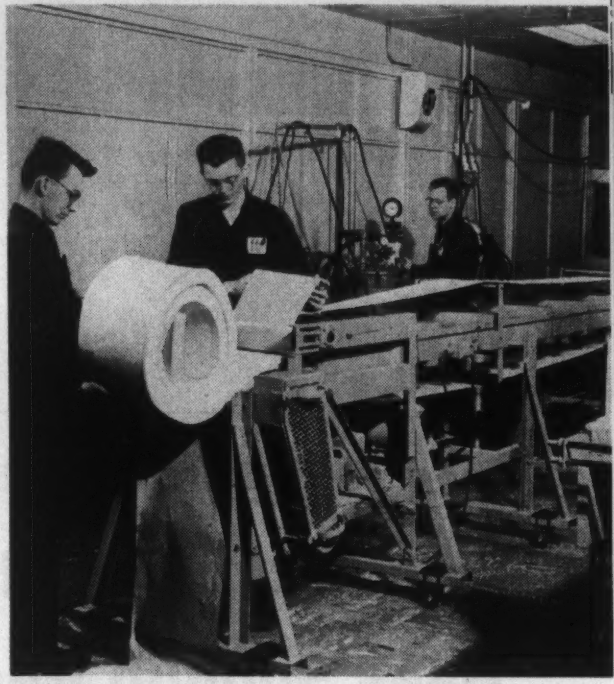
■ The surprisingly rapid acceptance of new materials during the last decade can in many cases be attributed to the aggressive service and development work of materials producers. One approach that is becoming increasingly widespread is the product development and technical service laboratory.

Du Pont's new rubber laboratory is the latest addition to this type of customer service development. The Elastomers Laboratory, located at Du Pont's technical service center at Chestnut Run, is designed to provide service data on neoprene, Hypalon synthetic rubber, Hylene organic isocyanates and rubber chemicals. Many operations in rubber manufacture can be duplicated on a pilot plant scale.

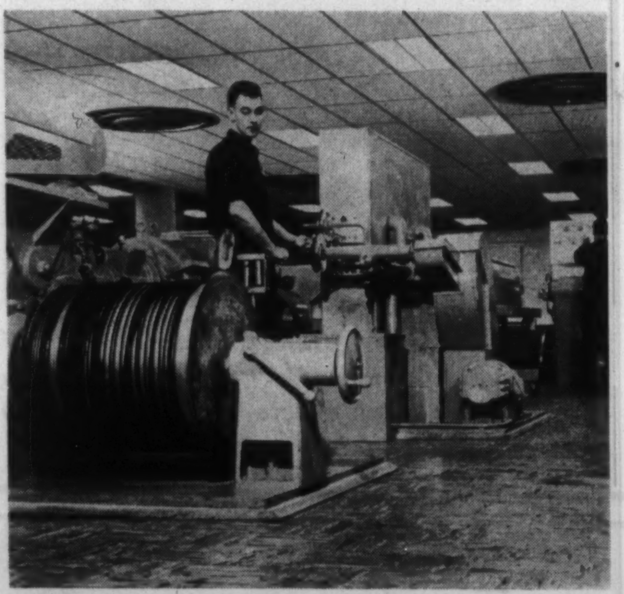
The laboratory is a necessary adjunct to Du Pont's rapidly expanding business in synthetic rubbers and rubber chemicals. The company is currently building a new neoprene plant at Montague, Mich., to add about 25% more production capacity, and a new plant is going up at Beaumont, Tex., to manufacture Hypalon synthetic rubber. The urethane field is also expected to grow in importance, and toward that end Du Pont will produce some 25 million pounds per year of organic isocyanate, one of the intermediates used in polyurethane manufacture.

Separate areas are provided in the Elastomer Laboratory for work on isocyanates, adhesives, paper, dry-polymer processing, latex, physical testing and consumer product testing. The scope of the new laboratory is illustrated by the fact that it is equipped to manufacture tire threads, apply them to carcasses, then cure and test the finished tires.

Other features include: an experimental unit for continuous manufacture of urethane foams; a pilot plant installation for continuous extrusion of electrical wire coverings; rubber mills on which speeds and ratios can be varied and stocks may be milled at any temperature from 50 to 330 F; and a specially built press that can operate at temperatures up to 500 F for the purpose of studying greatly accelerated curing rates and high speed molding techniques.

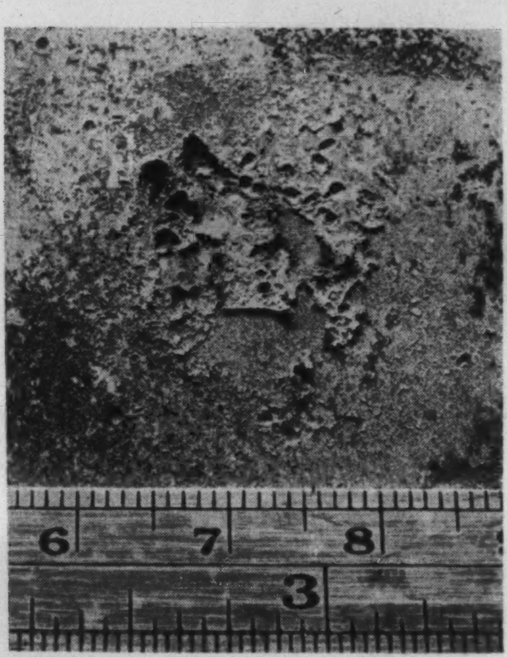


Isocyantes *Experimental unit for the continuous manufacture of urethane foams aids the study of production techniques.*



Wire covering *New Elastomers Laboratory has wire covering equipment for technical service work on neoprene.*

High Speed Airborne Dust Erodes Metal Surfaces



Dust damage *Surface of an aluminum plate ½ in. thick after being subjected to dust particles traveling at speeds up to 4000 ft per sec.*

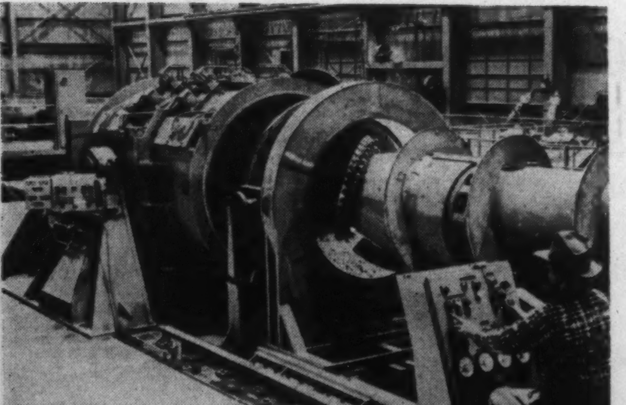
■ Dust particles traveling at 4000 ft per sec can penetrate a copper plate 0.008 in. thick and extensively damage the surface of a ½-in. thick aluminum plate. These facts were reported by E. H. Schulz, of Armour Research Foundation, who is studying the possible effects of airborne dust on satellite or missile surfaces.

If damage from the millions of dust specks is great enough, Dr. Schulz says, it could seriously diminish the chances of a missile or satellite fulfilling its mission. Preliminary tests have indicated that thin metal shields may not provide the necessary protection against meteoric dust for very high altitude flight.

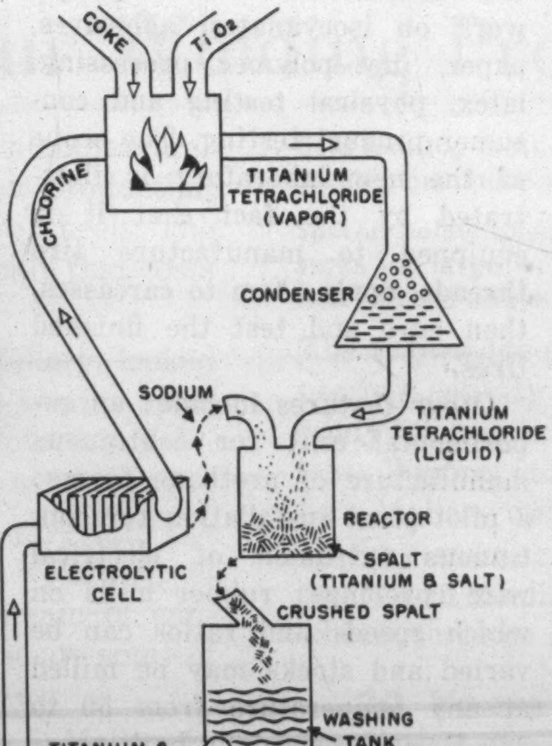
To simulate some of the hazards encountered in space flight, Armour researchers have developed a method for accelerating fine dust particles to speeds as high as 11,000 ft per sec, or more than 7000 mph.

Dust is loaded into the firing end of a shock tube which is then fired. The high pressure gases behind the shock wave expands to high velocity and carries the dust along. The dust particles shoot out of the opposite end of the shock tube and strike against the metal plate being tested. The size, quantity and velocity of the dust particles can be varied and controlled by adjusting shock tube parameters.

New Titanium Plant Uses Sodium Reduction Process



Titanium plant *Bottom view of reactor unit in horizontal position shows how reactor is drilled out to recover the sponge titanium.*



Titanium sponge *Diagram shows steps in the transformation of titanium ore into titanium sponge by the sodium reduction process.*

■ The recent start of operations in Electro Metallurgical Co.'s Ashtabula, Ohio, plant marked the first time that commercial titanium sponge had been produced in this country by a method other than the magnesium reduction process.

Electromet, a division of Union Carbide and Carbon Corp., uses sodium to reduce the titanium tetrachloride. The plant has a capacity of about 7500 tons of titanium metal sponge a year and is expected to reach its capacity production during the fourth quarter of this year.

The company adopted the sodium reduction process after extensive studies of other reduction methods. According to Electromet the sodium process is more economic and results in a metal of high quality. The titanium sponge will be shipped to producers of titanium mill products and commercial shapes for remelting into ingots.

Galvanizing line
Shearing end of a continuous coil galvanizing line.

Wean Engineering Co.

Supply good, consumption increasing but . . .

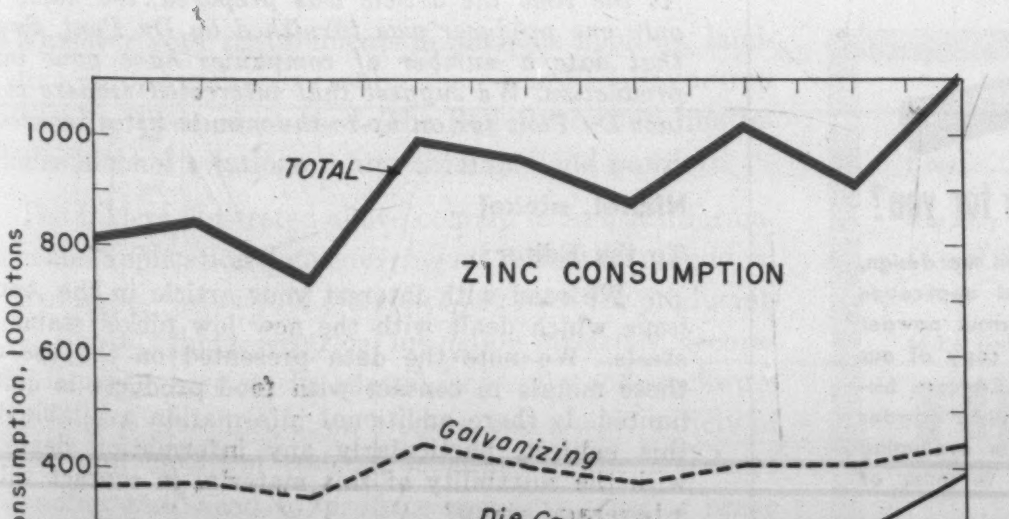
Zinc Producers Urged to Keep Price Attractive

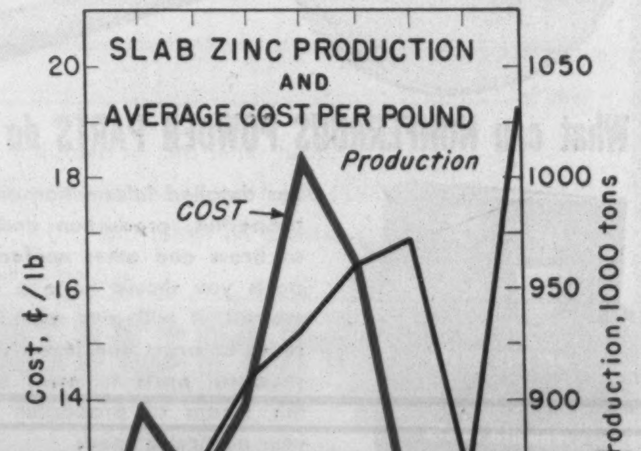
■ Zinc producers must maintain their favorable price record of the past few years to meet the relentless competition of substitute materials according Jean Vuillequez, vice president of American Metal Co., Ltd.

Speaking at the 38th annual meeting of the American Zinc Institute held recently in St. Louis, Mr. Vuillequez also emphasized the need for zinc producers to promote and search for new applications for their product. During the next ten years, zinc must find markets to increase its use by at least 35% if consumption is to keep pace with potential production.

As an example of the relationship between price and use, Mr. Vuillequez pointed out that the zinc casting alloys have exhibited greater relative price stability than have competing materials. As a consequence, die casters have been encouraged to find new applications in the automotive, home appliance, hardware and indus-

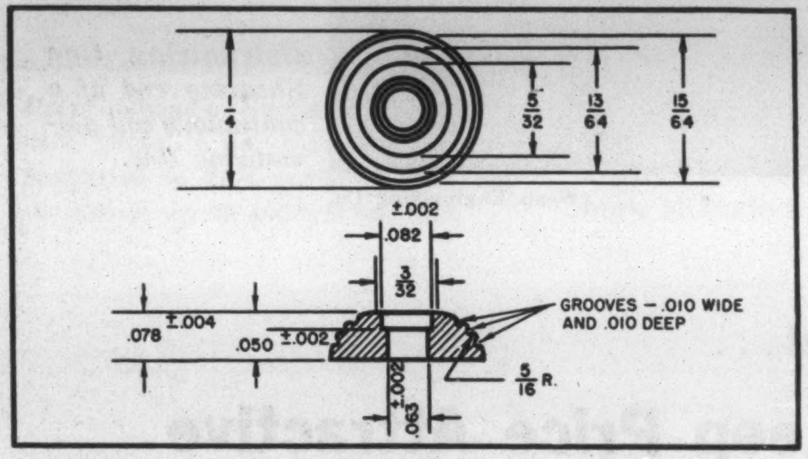
(Continued on p 264)





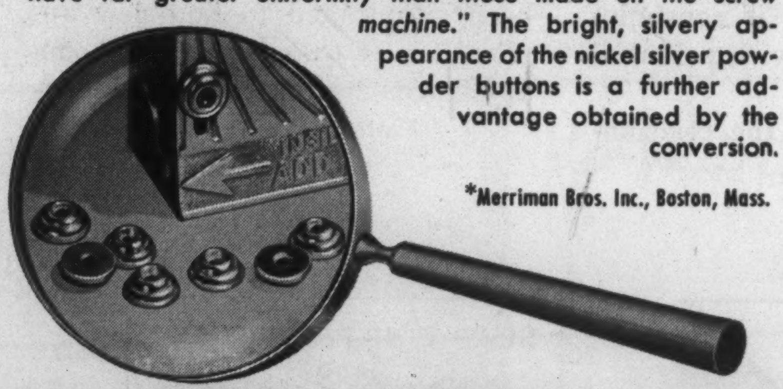
Master Rule Saves
Exactly 50% Per Button with-
NICKEL SILVER
POWDER
PARTS

MASTER
TUFBOY
MASTER
1
2

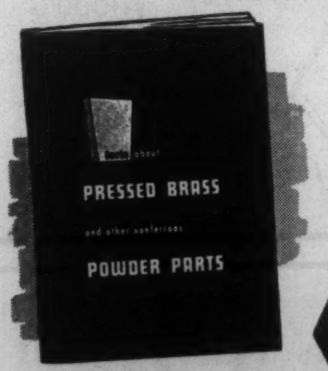


While the lock button (which holds measurements against creep) on the side of the "Tufboy" steel tape is a very *small* part of this overall assembly, *big* savings were obtained by turning to powder metallurgy. Formerly produced of stainless steel by screw machine at a cost of $.006 each, the buttons (below) are now pressed from nickel silver powder* at a 50% saving—$.003 each. Master Rule Manufacturing Co., Inc., states that, in addition to the lower cost, the nickel silver powder buttons *"have far greater uniformity than those made on the screw machine."* The bright, silvery appearance of the nickel silver powder buttons is a further advantage obtained by the conversion.

*Merriman Bros. Inc., Boston, Mass.



What can NONFERROUS POWDER PARTS do for you?



For detailed information on the design, properties, production and application of brass and other nonferrous powder parts you should have a copy of our manual. It will give you 24 case histories of brass and nickel silver powder structural parts to assist in evaluating this means of production in terms of *your* particular needs.

SEND FOR YOUR COPY

THE NEW JERSEY ZINC COMPANY
160 Front Street New York 38, N. Y.

HORSE HEAD PRODUCTS

For more information, turn to Reader Service Card, Circle No. 424

LETTERS TO THE EDITOR

Bonding Teflon

To the Editor:

We have read the April issue of MATERIALS & METHODS with extreme interest. We have always enjoyed the publication and gather a good deal from it.

On pages 118 and 119 of the April issue is an article entitled "Bonding Qualities of Teflon Improved by New Treatment." In paragraph three of this article reference is made to U. S. Gasket Co. as producing this material. We also manufacture this material and have done so from the time Du Pont released the technique. We thought that the readers of your publication would like to know that there is more than one source for this merchandise...

W. S. SHAMBAN
Shamban Engineering Co.
Culver City, Calif.

To the Editor:

In your April issue you have an article on the bonding qualities of Teflon. You mentioned that, "At present, U. S. Gasket Co. is producing cementable Teflon Tape in thicknesses of 5 to 60 mils, and sheets in thicknesses of 1/32 and 1/16 in."

We wish to point out that U. S. Gasket is not the only firm who is producing cementable Teflon. We at Dixon Corp. have been doing this for approximately three months. We are in a position to supply any Teflon part with one or all the surfaces treated for cementing. We also supply our Rulon bearing material as tape, sheets, and molded parts with surfaces treated for cementing . . .

ROBERT RULON MILLER, President
Dixon Corp.
Bristol, R. I.

At the time the article was prepared, the name of only one producer was furnished by Du Pont. Since that date a number of companies have gone into production. We suggest that interested readers contact Du Pont for an up-to-the-minute list of sources.

Nickel, nickel

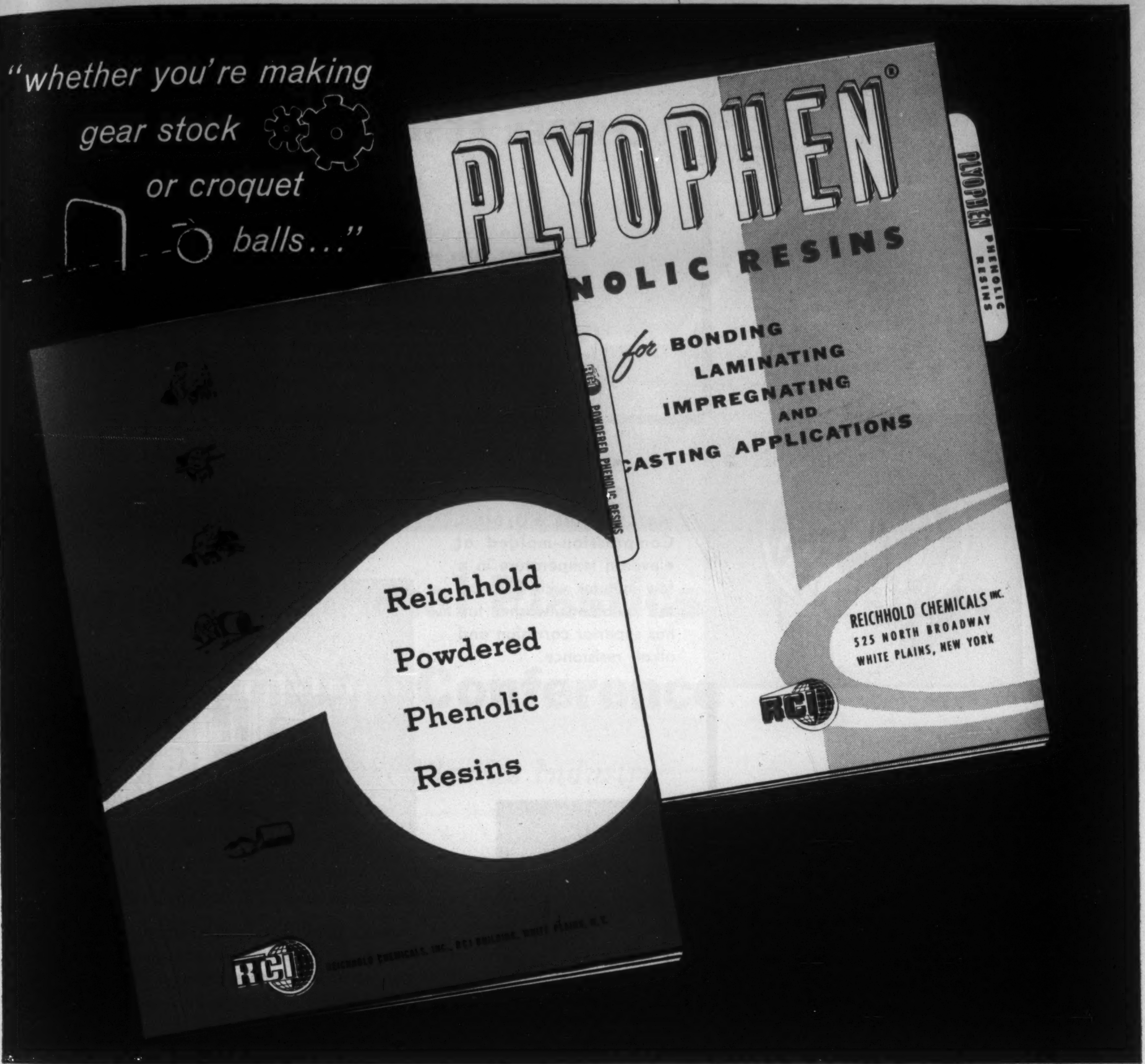
To the Editor:

We read with interest your article in the April issue which dealt with the new low nickel stainless steels. We note the data presented on the use of these metals in contact with food products is quite limited. Is there additional information available on this subject, particularly any information dealing with the suitability of this material in contact with a beverage syrup?

LENOX K. PICKERING, Chief Engineer
Test & Development Div.
Pepsi-Cola Co.
Long Island City, N. Y.

Unfortunately there is very little information available on corrosion of the 200 series steels, in particular

(Continued on p 280)


"whether you're making
gear stock
or croquet
balls..."
PLYOPHEN®
PHENOLIC RESINS
for BONDING
LAMINATING
IMPREGNATING
AND
CASTING APPLICATIONS
REICHHOLD CHEMICALS INC.
525 NORTH BROADWAY
WHITE PLAINS, NEW YORK
RCI
PLYOPHEN PHENOLIC RESINS
POWDERED PHENOLIC RESINS
Reichhold
Powdered
Phenolic
Resins
RCI
REICHHOLD CHEMICALS, INC., RCI BUILDING, WHITE PLAINS, N.Y.

RCI'S FULL LINE OF PHENOLICS CAN FILL ALL YOUR NEEDS

● Whatever your requirements in phenolic bonding, laminating, impregnating or casting, there's an RCI PLYOPHEN tailored to your exact need. The RCI PLYOPHEN line includes alcohol solutions, water solutions and powders.

The folders illustrated above contain technical information and application data covering more than 40 individual PLYOPHENS — *the liquid phenolics* you need for producing gear stocks, tubing, electrical insulation materials, decorative laminate core stocks, plastic faced plywood, rockwool and fibrous glass insulation binders, and a wide variety of water and chemical resistant coatings — *the powdered phenolics* you need to produce grinding wheels, brake linings, insulating varnishes, wood waste products and molding compounds.

Send for the RCI PLYOPHEN folder which can help you get the right phenolic resins for your needs. *Attach the coupon at right to your letterhead.*

My Name is________________________

I am________________________of the
(TITLE)
company indicated on this letter head.

I would like: ( ) RCI folder on liquid PLYOPHENS
( ) RCI folder on powdered PLYOPHENS

to be sent to me by:

REICHHOLD

Synthetic Resins • Chemical Colors • Industrial Adhesives • Plasticizers
Phenol • Formaldehyde • Glycerine • Phthalic Anhydride • Maleic Anhydride
Sodium Sulfite • Pentaerythritol • Pentachlorophenol • Sulfuric Acid

REICHHOLD CHEMICALS, INC.,
RCI BUILDING, WHITE PLAINS, N. Y.

Creative Chemistry . . .
Your Partner in Progress

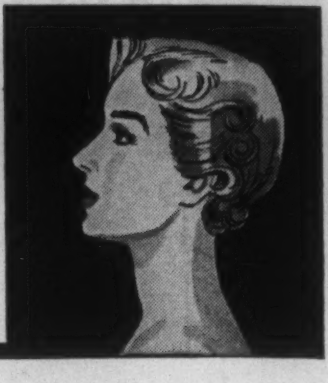
Visit the 7th National Plastics Exposition, New York Coliseum June 11-15, 1956

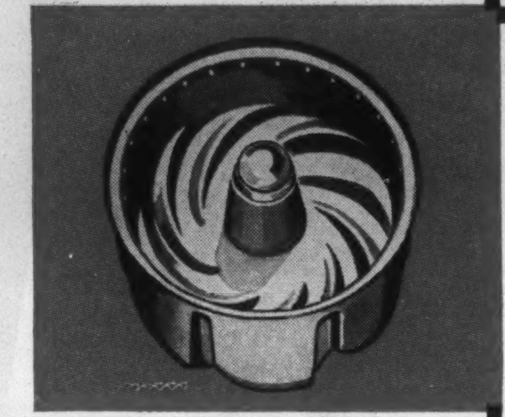
For more information, turn to Reader Service Card, Circle No. 459

THERE'S A

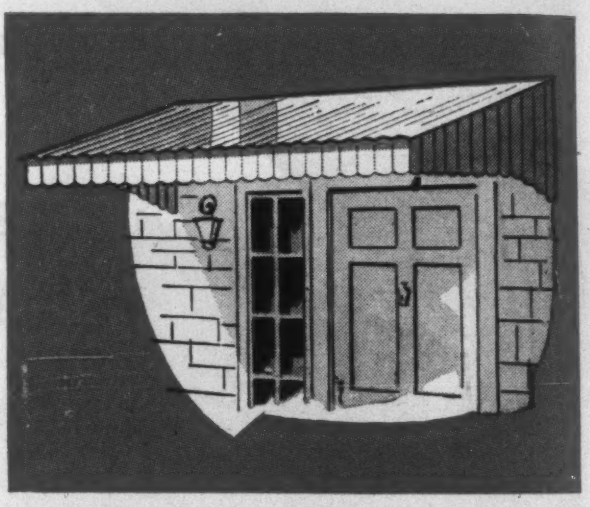
GLIDPOL* **POLYESTER RESIN FOR EVERY PURPOSE**

HAND LAYUP, ROOM TEMPERATURE-CURE MOLDING
Made of reinforced GLIDPOL resin, this eye-appealing display mannequin is molded and cured at room temperature without the introduction of heat.

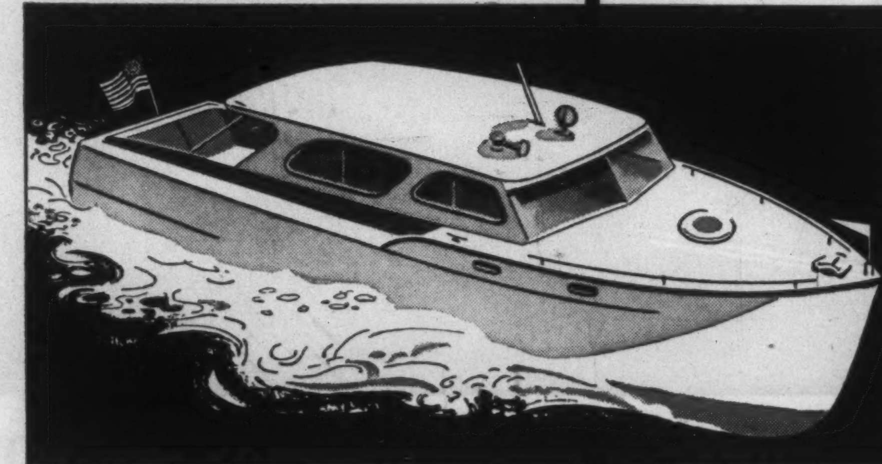




MATCHED DIE MOLDING
Compression-molded at elevated temperature in a few minutes with GLIDPOL, this automatic washer tub has superior corrosion and alkali resistance.



LAMINATING WITH PIGMENTED STABLE RESIN. These colorful, weatherproof awnings, laminated with pigmented GLIDPOL, offer excellent light stability and permanent locked-in color.

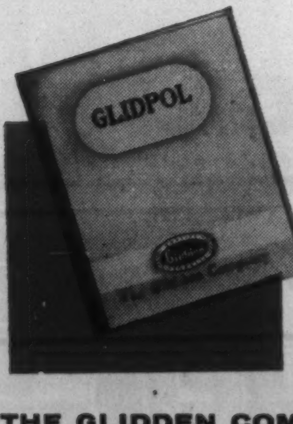


PROTECTIVE COATING APPLICATION
The wooden hull of this handsome cabin cruiser is coated with GLIDPOL to provide maximum water and abrasion resistance, hardness and lasting high gloss.

All of your service and molding requirements can be met by one of the GLIDPOL family of polyester resins. GLIDPOL provides superior wetting of the glass fibers, maximum corrosion resistance to water and most common chemicals with uniform quality from batch to batch.

Glidden-controlled manufacture of GLIDPOL helps insure rapid, uniform cure at elevated or room temperatures without cracking or crazing. You can use GLIDPOL in your laminating, molding, impregnating, casting, potting and coating operations.

*A Glidden Trade-Mark



For complete, detailed specification data on GLIDPOL resins, write (on your company letterhead) for Technical Bulletin MM-656.

GLIDPOL
POLYESTER RESINS

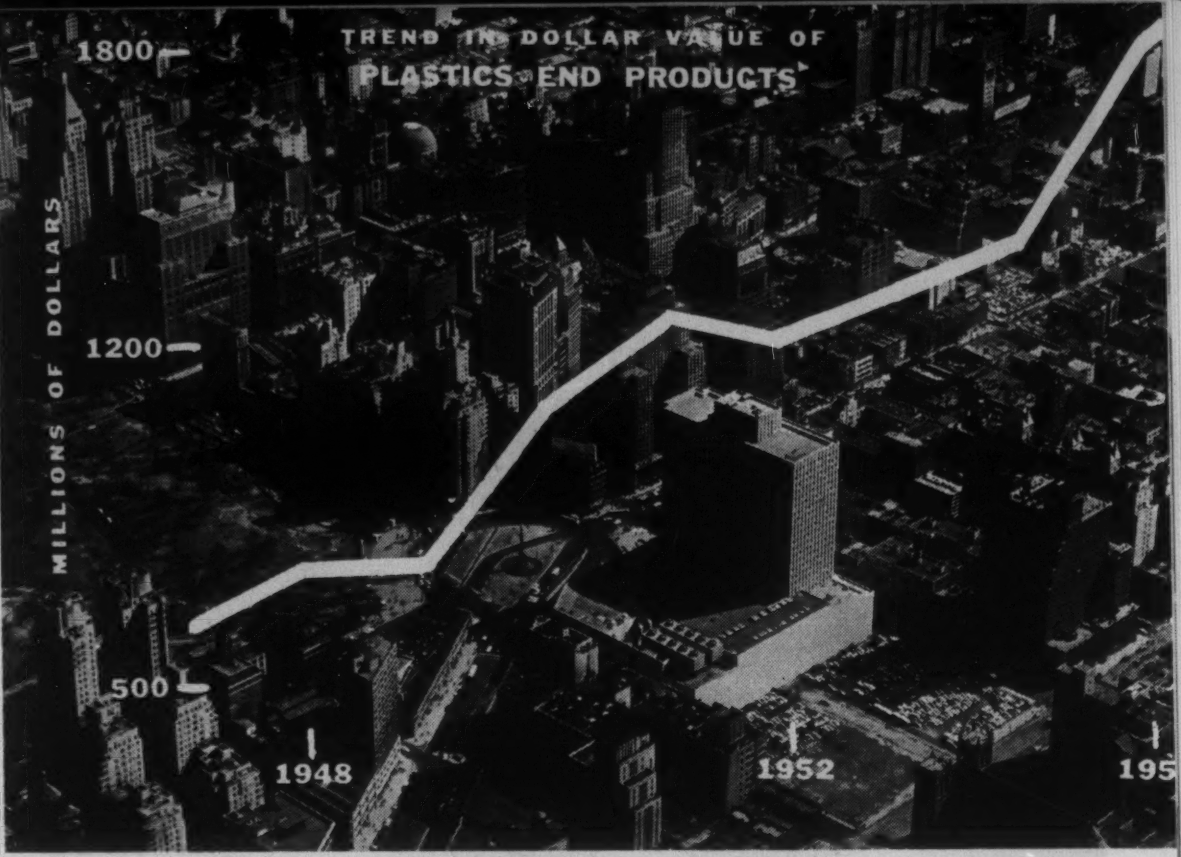
QUALITY Glidden PRODUCTS

THE GLIDDEN COMPANY • INDUSTRIAL FINISHES DIVISION • 11005 MADISON AVENUE, CLEVELAND 2, OHIO
San Francisco • Los Angeles • Chicago (Nubian Division—1855 N. Leclaire Ave.) • Minneapolis • St. Louis • New Orleans • Cleveland • Atlanta • Reading. Canada: Toronto and Montreal

For more information, turn to Reader Service Card, Circle No. 580

PREVIEW

June 11-15, 1956



Seventh National Plastics Exposition ... and Annual Conference

Sponsored by Society of the Plastics Industry

The Exposition

Over 230 companies will exhibit the latest developments in plastics during the Seventh National Plastics Exposition to be held this month, June 11-15, in New York City.

The exposition will be held in New York's new Coliseum at Eighth Ave. and 58th St. and will be open to visitors daily from 12 noon to 6 p.m. Admission will be restricted to properly registered representatives of industry, education and government.

Exhibitors will include: injection and compression molders; laminators; extruders; reinforced plastics molders; film, sheeting and coated fabrics processors; raw materials suppliers; machinery and equipment manufacturers; tool, die and mold makers; and testing and research laboratories. A complete list of exhibitors, up-to-date at press time, appears on pp 23 and 25.

Visitors are extended a cordial invitation to visit the Materials & Methods booth (No. 437) where plastics materials and applications covered in recent articles will be on display.

How to Register

Registration for the Plastics Exposition is free and can be made at the Coliseum at any time during exhibiting hours—12 noon to 6 p.m., June 11-15. Registration blanks can be obtained in advance from any exhibitor.

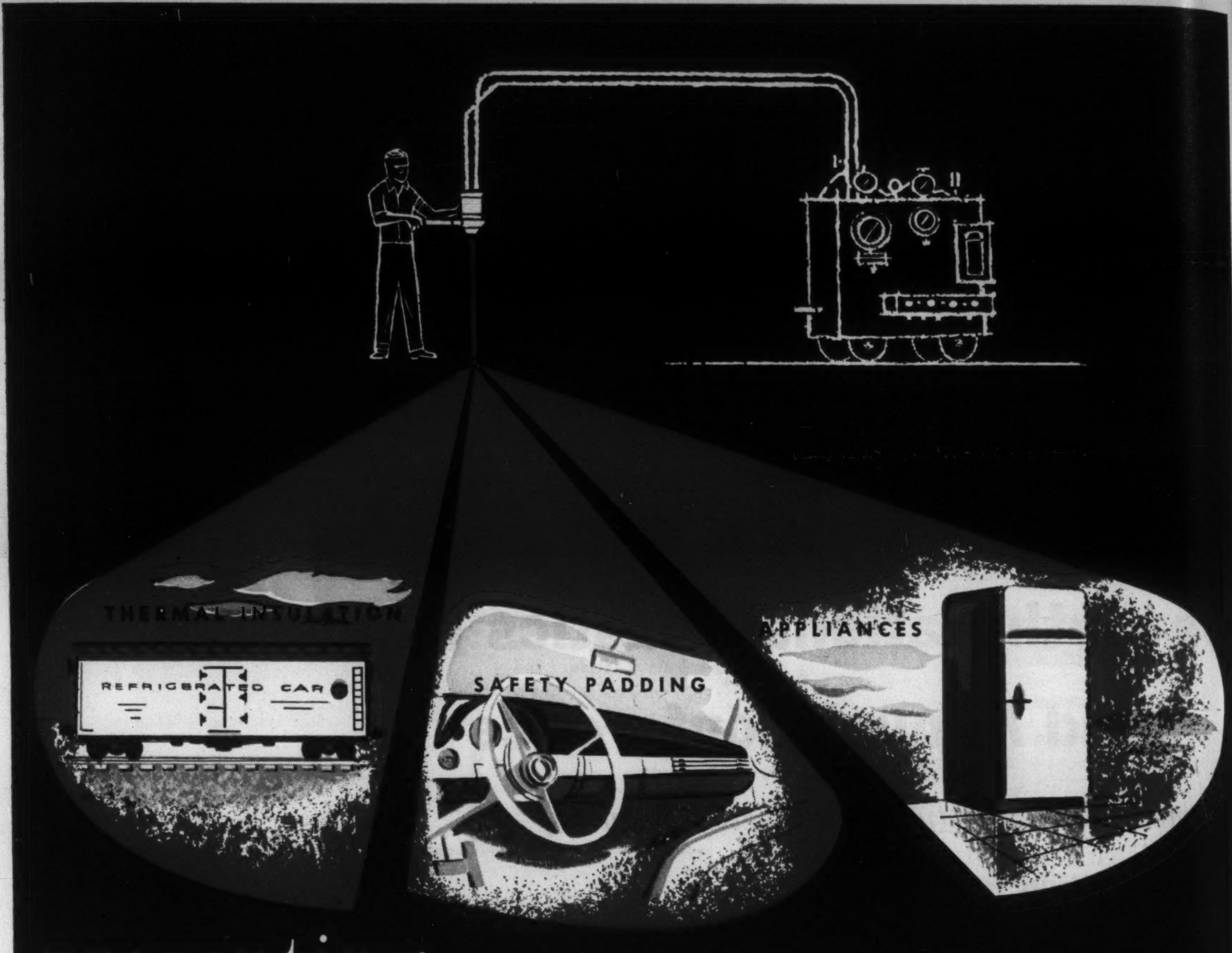
Registration for the Annual Conference can be made at the SPI desk on the Ballroom Foyer of the Commodore Hotel starting Sunday, June 10, at 2 p.m. and from 8:30 a.m. to 12 noon June 11-15. The conference fee, $25 for SPI members and $30 for nonmembers, also covers the SPI Reception and a Moonlight Cruise.

The Conference

The Annual Conference of the Society of the Plastics Industry will be held concurrently with the exposition. All sessions will meet in the Commodore Hotel, 42nd St. and Lexington Ave. Opening day (Monday) sessions will start at 10 a.m.; thereafter, conference sessions will run from 9:30 a.m. to 12 noon.

The conference will bring together all segments of the plastics industry in technical sessions aimed at coordinating developments in materials and production methods with the consuming industries. The five industries taking part in the program are automotive, refrigeration and air conditioning, packaging, building materials and communications. In each industry the range of subjects will cover new materials, new applications, design considerations, forming methods and the future outlook. A detailed program, up-to-date at press time, appears on pp 19 and 21.

Question and answer periods after papers are given will enable every registrant to take part in the conference.



presenting

THE NOPCOMETER

New automatic metering, mixing and dispensing unit for all **NOPCO LOCKFOAM** plastics

ASSEMBLY-LINE APPLICATION NOW POSSIBLE!

Now, many months of development have produced the NOPCOMETER—which makes mass production with Nopco Lockfoams a reality. Now you can meter, mix and dispense any of the Lockfoam formulations and deliver to your production line a predetermined charge of Lockfoam, *automatically*...and *intermittently*.

The Nopcometer makes possible assembly line manufacture of both small and large units. It can deliver Lockfoam of any required density at varying rates up to 15 pounds per minute.

Nopco Lockfoam can be *foamed-in-place* to fill any cavity regardless of size or configuration. Its light weight, great strength, resistance to chemicals and superior insulating qualities meet more than ever the specifications of *both* design engineering *and* production. In less than 25 minutes a section of 320 sq. ft. x 6" thick can be foamed. Similar time saving performance is made possible in auto crash pads, refrigerator panels and other products.

Nopco's technical staff is prepared to give assistance in operating the Nopcometer as well as to continue helping you develop Lockfoam formulations designed specifically to produce the best results for you at maximum economy. We welcome your inquiry.

NOPCO

PLASTICS DIVISION

HARRISON, NEW JERSEY • Los Angeles, Calif.

For more information, turn to Reader Service Card, Circle No. 554

Program

1956 SPI Annual Conference

Commodore Hotel, New York City

Monday, June 11

10 a.m. (two concurrent sessions)

Cellular Plastics in the Transportation Industry
East Ballroom

Opening Remarks: SAMUEL STEINGISER, Mobay Chemical Co.

Presiding: PAUL ROACH, U. S. Rubber Co.

Speakers:

"Cellular Plastics Applications in Ships"—JOHN B. ALFERS, Navy Bureau of Ships

"Cellular Plastics in Subway Seating"—JAMES R. MCCORMICK, New York City Transit Authority

"Uses of Cellular Plastics in the Aircraft Industry"—STANLEY T. LIPPERT, Douglas Aircraft Co., Inc.

"Cellular Plastics in the Automotive Industry"—E. J. STORFER, Chrysler Corp.

"Applications for Cellular Plastics in Trains"—IRVING EINHORN, Budd Co.

Sheet Forming—West Ballroom

Presiding: JOHN W. KNIGHT, Fabri-Form Co.

Speakers:

"Use of Sheet Formed Plastics in Packaging Applications"—ROBERT N. FISHER, Stanley Works

"Applications and Requirements for Formed Sheets in the Appliance Industries"—ROBERT DIXON, Westinghouse Electric Corp.

Panel: "Transportation Applications for Sheet Formed Plastics"

Moderator: A. E. POLSON, Goodyear Tire & Rubber Co.

Automobiles—RICHARD F. HINTERMEISTER, Ford Motor Co.

Trains—RALPH HAMAN, Pullman Standard Car Mfg. Co.

Aircraft—HAROLD H. ROSENBAUM, Convair, Div. of General Dynamics Corp.

Ships—F. A. HEESS, JR., Moore-McCormack Lines, Inc.

Tuesday, June 12

9:30 a.m.

Keynote Addresses: "Plastics Shaping Tomorrow's Products"—Grand Ballroom

Presiding: WILLIAM T. CRUSE, executive vice president, SPI

Speakers:

Automotive—HARRY E. CHESEBROUGH, Chrysler Corp.

Packaging—C. W. HARPER, Informative Packaging and Labeling Div., Sears, Roebuck and Co.

Building Materials—RALPH WALKER, FAIA, Voorhees, Walker, Smith and Smith

Refrigeration and Air Conditioning—GEORGE TAUBENECK, *Air Conditioning and Refrigeration News*

Communications—W. O. BAKER, Bell Telephone Laboratories, Inc.

6 p.m.

SPI Annual Reception—Grand Ballroom

Wednesday, June 13

9:30 a.m. (three concurrent sessions)

Automotive Session—Grand Ballroom

Presiding: W. M. PORTER, Plastics Div., Celanese Corp. of America

Speakers:

"Trends in Automotive Styling"—DUNCAN MCRAE, Studebaker-Packard Corp.

"Plastics Automotive Components"—A. J. CARTER, Chrysler Corp.

"Advances in Body Manufacturing Techniques"—JOHN G. COFFIN, Chevrolet Div., General Motors Corp.

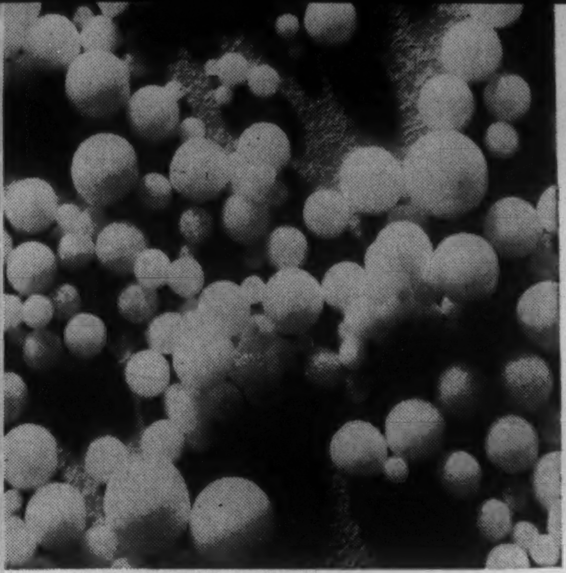
Packaging Session—East Ballroom

Presiding: S. W. JONES, JR., M. W. Kellogg Co.

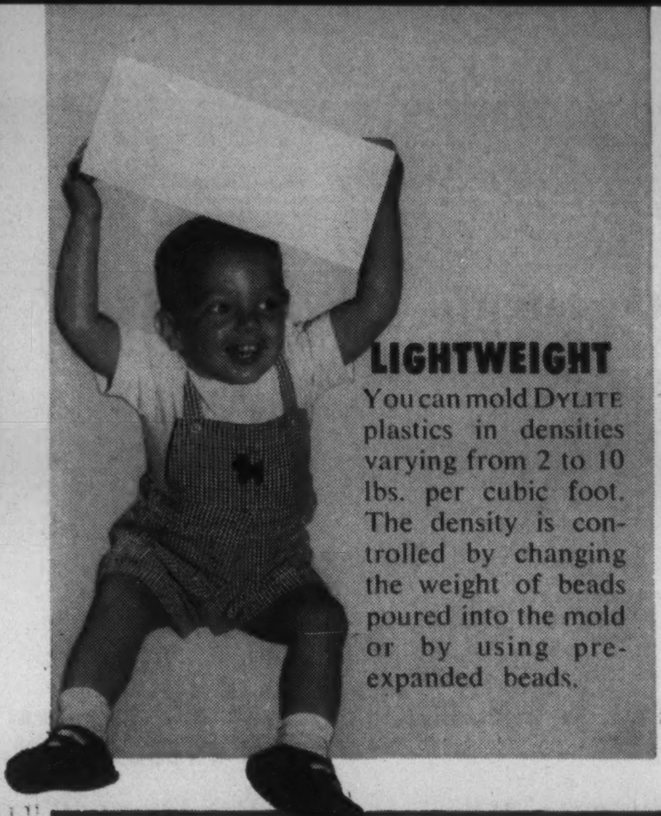
Speakers:

"New Developments in Flexible Packaging"—THOMAS R. BAXTER, Flexible Packaging Div., Shellmar-Betner Div., Continental Can Co., Inc.

(Continued on p 23)



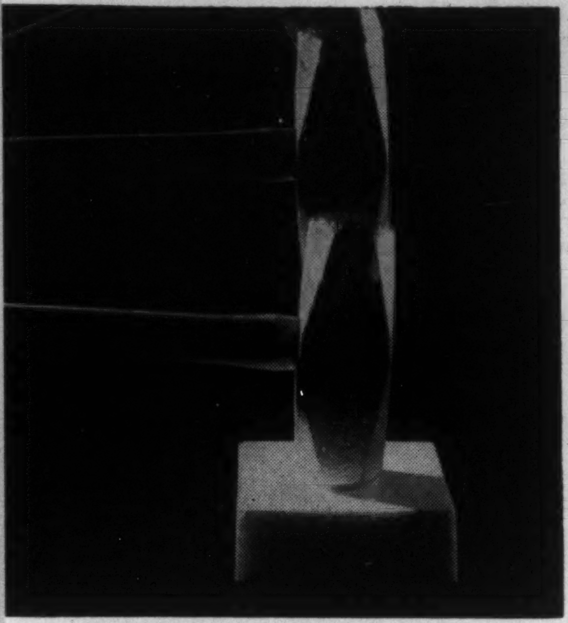
FOAMED PLASTIC — Koppers sells DYLITE expandable polystyrene in the form of sugar-size granules. You simply put the beads in a mold, properly apply heat, and they puff up to fill the entire cavity.



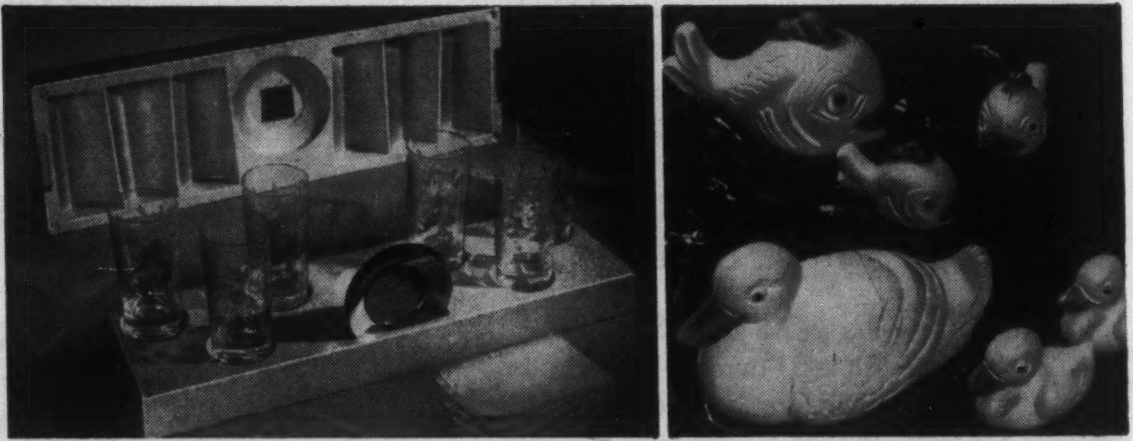
LIGHTWEIGHT
You can mold DYLITE plastics in densities varying from 2 to 10 lbs. per cubic foot. The density is controlled by changing the weight of beads poured into the mold or by using pre-expanded beads.

STRONG — Blocks of DYLITE expandable polystyrene will support tremendous weight. Products made of this plastic contain millions of tiny plastic cells that are fused together to form a tight, tough mass.

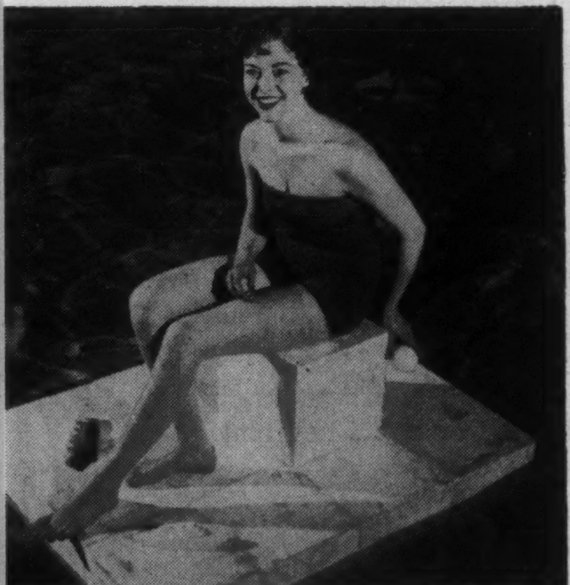
Look what you can do with DYLITE* expandable polystyrene



SHOCK ABSORBENT — DYLITE plastic is tough enough to absorb the impact of a sharp blow. The surface cells simply cushion the transmission of shock through the plastic.



EASY TO MOLD — You can mold DYLITE expandable polystyrene in almost *any* shape you want. DYLITE plastic can also be extruded into tubes, rods and sheets.



IT FLOATS — The foamed plastic is so light that it floats high in the water. Actually, a cubic foot of 2-pound-density DYLITE expandable polystyrene will support a 55-pound weight.

DYLITE expandable polystyrene has many uses

This amazing plastic has been on the market just 2 years. Already, it has been used to make toys and attractive packages; its excellent insulating properties have been put to use in ice buckets, ice-making machines, air conditioners and refrigerators; boat building companies are using it as a buoyant material in hulls. Samples of DYLITE expandable polystyrene are in the hands of many industrial development departments across the country. New uses for this plastic are continually being found.

Write to the Koppers Company, Inc., Chemical Division, Dept. MM-66, Pittsburgh 19, Pennsylvania for a free copy of "Imagineering for Profit."

*Koppers Trademark

KOPPERS

KOPPERS PLASTICS

SALES OFFICES: NEW YORK · BOSTON · PHILADELPHIA · ATLANTA · CHICAGO · DETROIT · HOUSTON · LOS ANGELES

In Canada: Dominion Anilines and Chemicals Ltd., Toronto, Ontario

Program—SPI 1956 Annual Conference (continued)

"New Developments in Rigid Packaging"—LLOYD STOUFFER, *Modern Packaging*

"A Review of Vacuum Formed Visual Packages"—E. BOWMAN STRATTON, JR., Auto-Vac Co.

"Progress Report on FDA Legislation"—ELLIOT BALESTIER, JR., Visking Corp.

Building Materials Session—West Ballroom

Presiding: David Guarnaccia, Monsanto Chemical Co.

Speakers:

"Plastics Today in Buildings"—ALBERT G. H. DIETZ, Massachusetts Institute of Technology

"Approach to Code Problems"—F. J. RARIG, Rohm & Haas Co.

"Plastics Tomorrow in Buildings"—ROBERT FITCH SMITH, architect, AIA

Presentation: Plastics House Competition Awards—Philip A. Belk, chairman, SPI Public Relations Committee

12:30 p.m.

Luncheon, SPI Annual Meeting—Grand Ballroom

Presiding: Norman Anderson, president of SPI

Business: Society reports, announcement of new SPI officers

Speaker: "Status of Federal Communications Commission's Proposed Changes in Rules and Regulations Covering the Use of High Frequency Equipment for Molding and Heat Sealing"—JEROME H. HECKMAN, Dow, Lohnes and Albertson

6:30 p.m.

International Reception and Dinner—St. Moritz Hotel, Burgundy Room

Presiding: Tino Perutz, Omni Products Corp.

Program: Accredited overseas visitors will speak on conditions in the plastics industry in their respective countries

Thursday, June 14

9:30 a.m. (two concurrent sessions)

Refrigeration and Air Conditioning Session—Grand Ballroom

Presiding: ISLYN THOMAS, Newark Die Co., Inc.

Speakers:

"Sheet Forming and Extrusion"—D. A. DAVIS, Major Appliance Div., General Electric Co.

"Moldings"—ROY V. JOHNSON, Midwest Mfg. Co.

"Insulation"—O. H. YOXSIMER, Westinghouse Electric Corp.

Communications Session—West Ballroom

Presiding: George H. Reed, American Hard Rubber Co.

Speakers:

"Trends in Extrusion Materials for Communications Wire and Cable"—J. B. HOWARD and V. T. WALLDER, Bell Telephone Laboratories, Inc. (delivered by HOWARD)

"Encapsulation and Miniaturization"—WILLIAM CUMING, Emerson & Cuming, Inc.

"The IBM Molded Flush Circuit"—RICHARD M. BELL, Plastics Laboratory, International Business Machines Corp.

"Plastics in Telephone Instruments"—GEORGE A. WAHL, Bell Telephone Laboratories, Inc.

12:30 p.m.

Luncheon—Grand Ballroom

Presiding: WALTER J. A. CONNOR, American Plastics Corp.

Speaker: "A Behind-the-Counter View of Plastics"—PHILIP M. TALBOTT, president, National Retail Dry Goods Assn.

Announcement: Plans for the forthcoming Informative Labeling Awards—PHILIP A. BELK, Hercules Powder Co.

6 p.m.

Moonlight Cruise

Schedule: M. V. Liberty Belle leaves Wilson Line Pier, West 42nd St., at 7 p.m. Reception at 6 p.m., buffet dinner at 7 p.m. and dancing until 12:30 a.m.

Friday, June 15

9:30 a.m.

SPI Molders' Management Division Meeting—Grand Ballroom

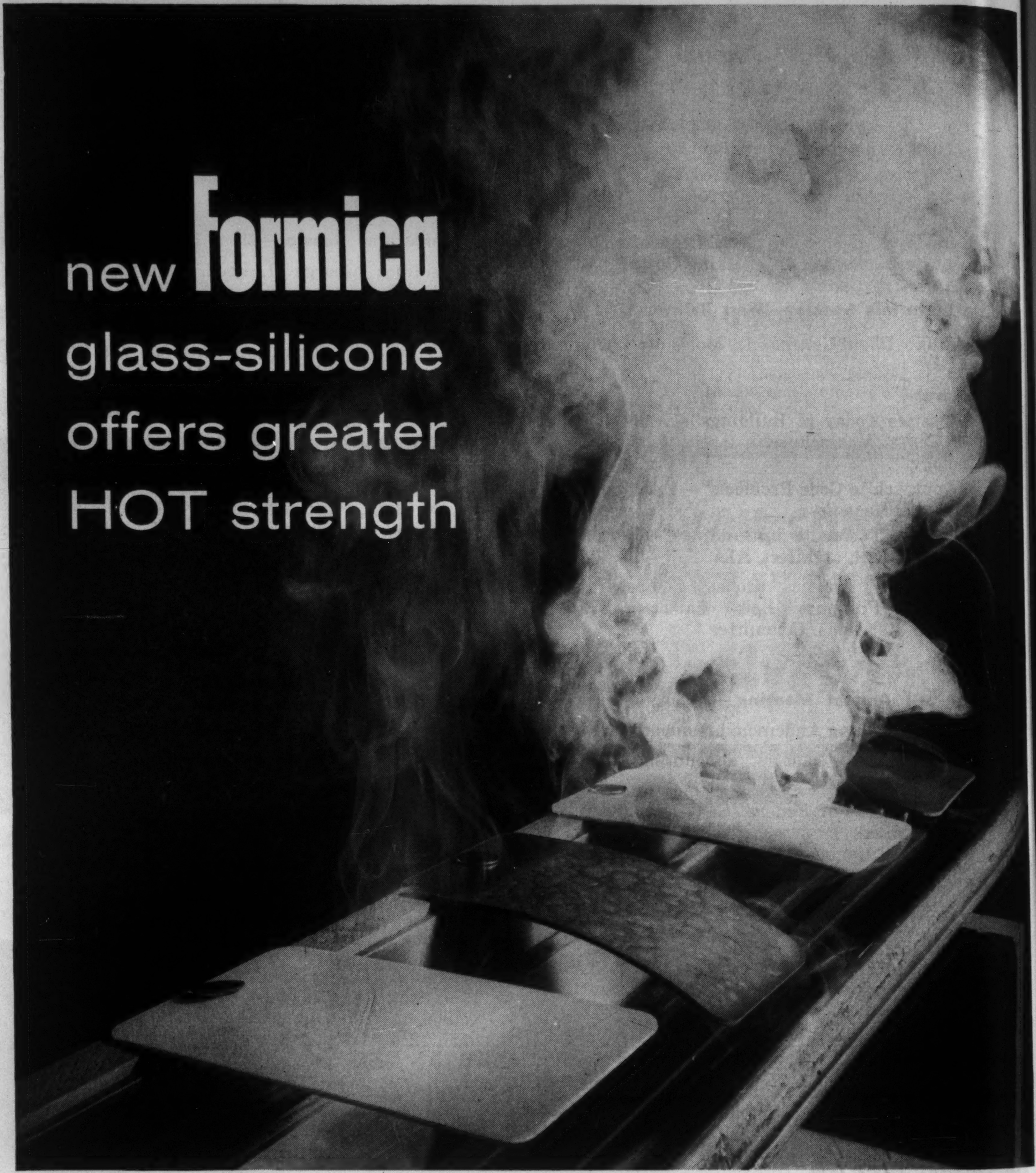
Presiding: NED H. PORTE, General American Transportation Corp.

Speaker: "Sound Costing Practice"—FRANK WALLACE, Peat, Marwick, Mitchell & Co.

Committee Reports: Labor Relations, Estimating, Supplier Relations, Insurance on Molds, Sales Department Policies

(List of Exhibitors on p 23)

◄ For more information, Circle No. 550



New Formica G-7-2 silicone offers five characteristics for broader application:

1. Greater hot strength.
2. Lower moisture absorption (.12% after 24 hrs. immersion).
3. Lower wet power factor (.008).
4. Larger and thicker sheets (up to 36" x 72" x 2").
5. Uniform creamy white color.

The photo above dramatically demonstrates the outstanding hot strength property of Formica's new G-7-2. A withering blast from the lab heater causes three ordinary laminated plastics to smoke, char, blister and bend. But G-7-2 comes through this grueling test unmarked, its mechanical and electrical properties virtually unaffected.

G-7-2 is approved under military spec MIL-P-997-B, type GSG.

The unusual properties of G-7-2 are especially useful in guided missiles, radar, radio and tv, motors and generators and other electrical/electronic applications. Recommended for printed circuitry. For complete information, send today for free G-7-2 data sheets. Formica Corporation, subsidiary of American Cyanamid, 4678 Spring Grove, Cincinnati 32, O.

FORMICA 4

1st choice in laminated plastics
Application engineering • Fabricating
Research • Customer stock service

For more information, turn to Reader Service Card, Circle No. 560

Exhibitors

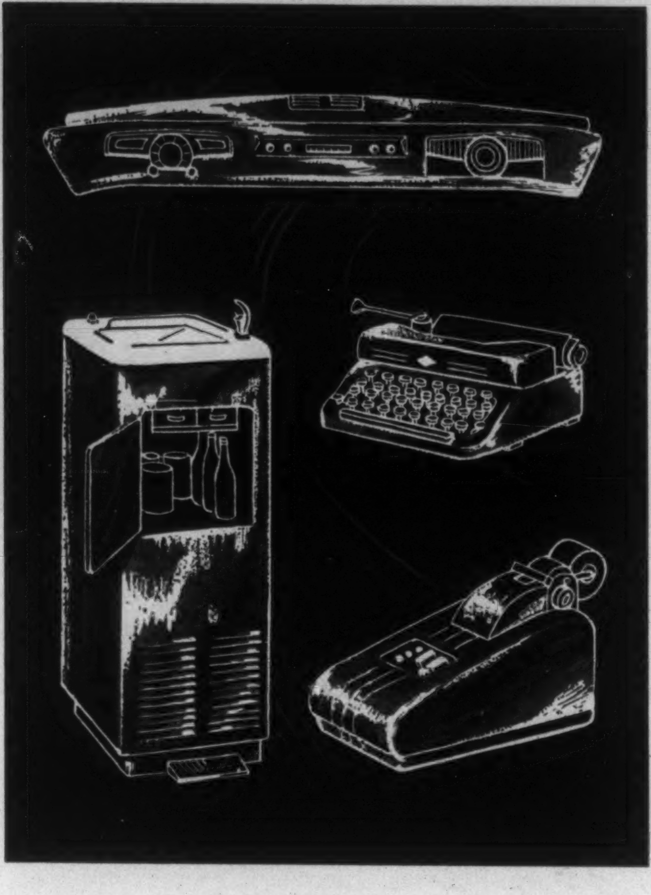
Seventh National Plastics Exposition

Coliseum, New York City

A & S Steel Rule Die Corp.	536
Acme Machinery and Mfg. Co., Inc.	6
Alsteele Engineering Works, Inc.	1209
American Cyanamid Co., Plastics & Resins Div.	906, 1005
American Plastics Corp.	615
American Tank and Machinery Corp.	308
Amos Molded Plastics, Div. of Amos-Thompson Corp.	206
Anchor Plastics Co., Inc.	327
Apex Machine Co.	616
Archer-Daniels-Midland Co.	322, 324
Atlas Vacuum Corp.	1238
Auto-Vac Co.	1142
Automatic Molding Machine Co.	1110
Avery Adhesive Label Corp.	102, 201
B.I.P. Engineering Ltd.	1030
Bakelite Co., Div. of Union Carbide and Carbon Corp.	809, 813, 817, 825
Baker Bros. Inc.	719, 721
Ball & Jewell, Inc.	725
Balsa Ecuador Lumber Co.	1219
Barber-Colman Co., Wheelco Instruments Div.	1106, 1108
Barrett Div., Allied Chemical & Dye Corp.	1029, 1035
Bassons Industries Corp.	636, 638
Belding Corticelli Industries	505
Bigelow Fiber Glass Products, Div. of Bigelow-Sanford Carpet Co., Inc.	942
B. Blacher	323
Borden Co., Chemical Div.	413, 415
Bramley Machinery Corp.	122
Cadillac Plastic and Chemical Co.	404
Camin Laboratories, Inc.	1217
Carbide and Carbon Chemicals Co., Div. of Union Carbide and Carbon Corp.	1126
Cast Optics Corp.	702
Catalin Corp. of America	836
Celanese Corp. of America	2, 205, 209, 213
Chemore Corp.	515, 517
Chicago Molded Products Corp.	526, 528
Chromium Corp. of America	537
Ciba Co., Inc.	331
Claremont Pigment Dispersion Corp.	1129
Coating Products	417
Commercial Plastics & Supply Corp.	525
Comet Industries	1210
Conforming Matrix Corp.	805
Consolidated Molded Products Corp.	312
Consolidated Vacuum, Div. of Consolidated Electrodynamics	706
Cosmos Electronic Machine Corp.	623
Cumberland Engineering Co., Inc.	5, 7
Custom Machine & Design Corp.	703
Dake Corp.	1109
Danielson Mfg. Co.	204
Joseph Davis Plastics Co.	1112
E. F. Decor, Inc.	27
Detroit Mold Engineering Co.	839
E. F. Decor, Inc.	27
Devoe & Raynolds Co., Jones Dabney Div.	1117
C. H. Dexter & Sons, Inc.	314
Dorrie Process Co.	845
Doven Machine & Engineering, Inc.	1141
Dow Chemical Co.	1017, 1025
E. I. du Pont de Nemours & Co., Inc., Film Dept.	328, 332
E. I. du Pont de Nemours & Co., Inc., Polychemicals Dept.	221, 225, 231
Dura Plastics, Inc.	301
Durable Formed Products, Inc.	1118
Durez Plastics Div., Hooker Electrochemical Co.	514, 516, 518, 520, 522, 524
Frank W. Egan & Co.	618, 620, 622
Eastman Chemical Products, Inc.	1006, 1010, 1012
Elastomer Chemical Corp.	801
Electromold Corp.	307
Elgood Materials Corp.	108
Emery Industries, Inc.	1002, 1004
Emet Vacuum Forming Corp.	1242
Entoleter Div., Safety Car Heating & Lighting Co., Inc.	617, 621
Erdco Engineering Corp.	13
Erie Resistor Corp.	305
Escambia Bay Chemical Corp.	1220, 1222
Exact Weight Scale Co.	730
Eyelet Specialty Co.	19
Famco, Inc., Div. of American Air Filter Co.	950
Farley & Loetscher Mfg. Co.	123
Fellows Gear Shaper Co.	405, 407, 409
Ferro Corp.	1130, 1132, 1134
Fiberesin Plastics Co.	631
Fiberite Corp.	325
Filon Plastics Corp.	519
Finish Engineering Co., Inc.	740, 742

(Continued on p 25)

idea page | *A new lift for your product, new products for your market*

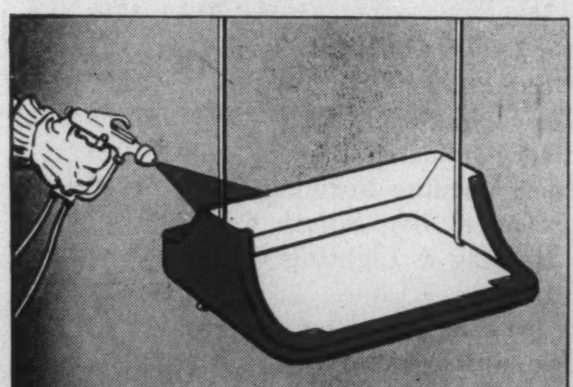


Pre-finished metal... Vinyl Clad

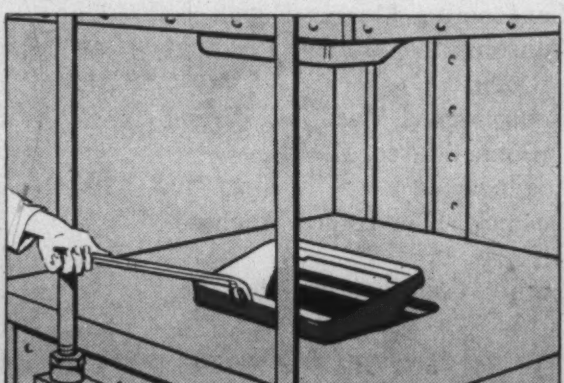
Now—dress up your products—before or during forming—with new vinyl clad metal. Combines appealing vinyl colors and textures with rugged strength of structural metal, eliminates final surface coating. Ideal for business machine housings . . . instrument panels . . . automobile dashboards . . . suitcases . . . commercial water-coolers . . . many other products. Vinyl coating gives sheet metals:

- *New texture, warmth, beauty*
- *Insulation against electricity, heat, cold*
- *Sound-muffling characteristics*
- *New abrasion and scratch resistance*
- *Resistance to acids, solvents, cleaners*

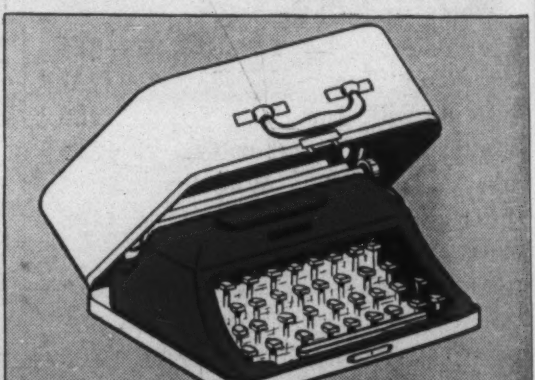
Can vinyl clad metal help you eliminate an expensive alloy . . . or by-pass a costly buffing or hand-polishing operation?



1. Custom processors can spray-coat your preformed metal parts with solution or dispersion vinyls; the spray coating can yield unique decorative effects. Vinyl plastic coating is **already pigmented**... no other finish is necessary...beauty is permanent.



2. Vinyl clad metal **sheets** are available, too. You can pressure-form your parts in your own factory... vinyl coating is flexible, will withstand stamping. Processors can also apply textured embossed surfaces, pressure-form the parts to your specifications.



3. Vinyl clad metal gives your product new sales appeal that bare structural metals or conventional finishes cannot offer... beauty, permanent colors, rust and corrosion resistance.

Monsanto does not make vinyl clad metals . . . only the chemical raw materials that go into the vinyl plastics. However, Monsanto would be pleased to put you in contact with custom-processors who can furnish samples, specific information, prices. Send brief description of your needs to: Organic Chemicals Division, MONSANTO CHEMICAL COMPANY, Dept. ID-2, St. Louis, Missouri.

Where Creative Chemistry Works Wonders For You

MONSANTO ®

For more information, turn to Reader Service Card, Circle No. 581

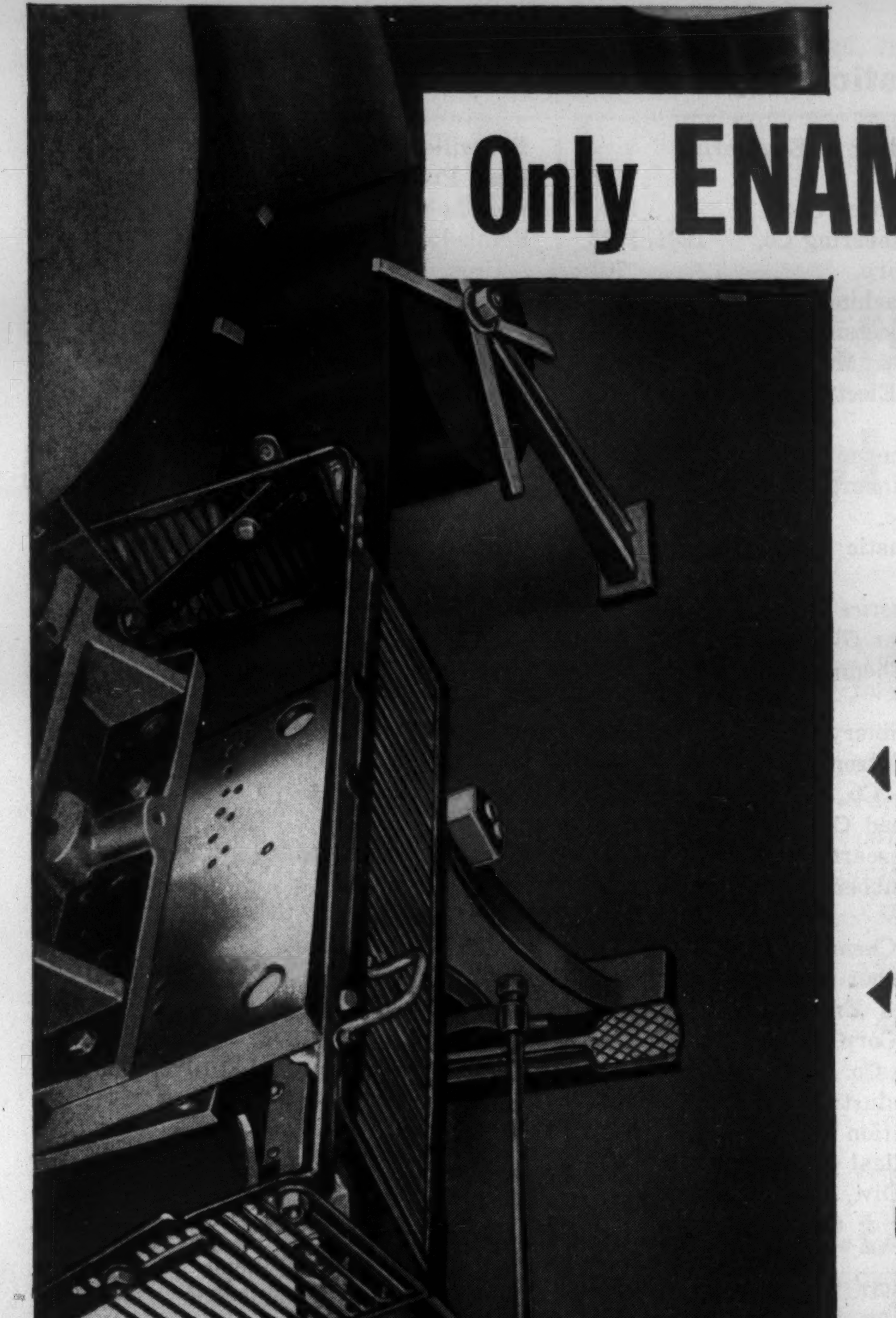
Exhibitors—Seventh National Plastics Exposition (continued)

Firestone Plastics Co.	831, 835
Flexigrip, Inc.	114
Flightex Fabrics, Inc.	1207
Foiltone Products, Inc.	713
Furane Plastics, Inc.	1103
General American Transportation Corp.	918
General Electric Co., Chemical Materials Dept.	302, 303
General Tire & Rubber Co.	712, 718
Gering Products, Inc.	944, 945
Gilman Brothers Co.	118
Glass Laboratories, Inc.	521
Glengarry Equipment Corp.	320
Glenn Electric Heater Corp.	736
B. F. Goodrich Chemical Co.	422, 426
Goodyear Aircraft Corp.	1113
Goodyear Tire & Rubber Co., Chemical Div.	806, 810
C. L. Gougler Machine Co.	1236
Guild Electronics, Inc., Dynatherm Div.	1101
Gurey Mfg. Co.	743
Harburger Eisen-und Bronzewerke A.G.	739, 741
Harchem Div., Wallace & Tiernan, Inc.	625, 627
Hartig Engine & Machine Co.	1114
Hays Mfg. Co., Reinforced Plastics Div.	126
Heat-Timer Corp.	829
H. H. Heinrich Co.	1144, 1146
Hendrick Mfg. Corp.	511
Hercules Powder Co.	830
Hopp Plastics, Div. of Hopp Press, Inc.	132
Hudson Foam Plastics Corp.	538
Hull-Standard Corp.	535
Hurlbut Paper Co.	732
Hydraulic Press Mfg. Co.	111, 113, 115, 117, 119
Hy-Sil Mfg. Co.	224
Ideal-Plastics Corp.	613
Improved Machinery, Inc.	1040, 1042
Industrial Gauges Corp.	1232
Industrial Mfg. Corp.	1120, 1122
Industrial Research Laboratories, Div. of Honolulu Oil Corp.	124
Instron Engineering Corp.	110, 112
Interchemical Corp.	1032, 1036
International Balsa Corp.	310
M. W. Kellogg Co.	804, 901
E. B. Kingman Co.	106
H. Kohnstamm & Co., Inc.	1235
Koppers Co., Inc.	414, 416
L.O.F. Glass Fibers Co.	306
Lafayette Saw & Knife Co.	1206
W. T. LaRose & Associates, Inc.	406
Leiman Bros., Inc.	36
Lemmon and Snoap	1240
Lester-Phoenix, Inc.	226, 232
Lewis Welding & Enginering Corp.	726
Lincoln Plastics Corp.	1229
Logan Engineering Co.	1231, 1233
Macbeth Corp.	701
Markem Machine Co.	1139
Martin Processing Co.	513
MATERIALS & METHODS	437
Mayflower Electronic Devices, Inc.	321
Metal & Thermit Corp.	1213, 1215
Miller Engineering Laboratories, Inc.	507
Modern Plastic Machinery Corp.	208
Modern Plastics	826
Molded Fiber Glass Co.	729, 731
Monsanto Chemical Co.	905, 909, 913, 917
Moslo Machinery Co.	628, 632
J. Frank Motson Co.	116
J. M. Nash Co., Inc.	1136
National Lead Co.	1039
National Research Corp.	713
National Rubber Machinery Co.	410
Naugatuck Chemical, Div. of U. S. Rubber Co.	812, 818
New Hermes Engraving Machine Corp.	105
Newark Die Co.	531
Newbury Industries	948
Nixon Nitration Works	315, 317
Nopco Chemical Co.	946, 1041
Ohio-Apex Div., Food Machinery & Chemical Corp.	841
Omni Products Corp.	432
Owens-Corning Fiberglas Corp.	420
Pantex Mfg. Corp.	11
Perry Plastics, Inc.	402
Phillips Chemical Co.	840, 939
Pittsburgh Coke & Chemical Co., Plasticizer Div.	624, 626
Plastic Molders Supply Co., Inc.	1234
Plastics Engineering Co.	137
Plastics Technology Publishing Co.	313
Plastics World, Cleworth Publishing Co.	902
Plax Corp.	926
Plaxall, Inc.	802
Polyform Plastics Corp.	319
Polymer Corp.	947, 949
Polyplastex United, Inc.	1225
Post Machinery Co., Electronic Products Div.	15, 17
Prodex Corp.	1009, 1013
Product Engineering	222
Radial Cutter Mfg. Corp.	509
Radio Corp. of America	1105
Radio Receptor Co., Thermatron Div.	326
Rainville Co., Inc.	1239, 1241
Reed Prentice Corp.	1018, 1026
Reichhold Chemicals, Inc.	910, 912
Reinhold Publishing Corp., Book Div.	437
Reliance Electric & Engineering Co.	23
J. A. Richards Co.	32
Roehlen Engraving Works, Inc.	1135
Rohm & Haas Co.	419, 421, 425, 431
Rubber & Asbestos Corp.	1226
J. Sandt, A. G. (for Atlas Shoe & Sewing Machine Co.)	1230
Sarco Co.	707
Sealomatic Electronics Corp.	1221
Shell Chemical Corp.	527
Sommers Plastic Products Co.	842
South Florida Test Service	311
Spencer Chemical Co.	237
Standard Tool Co.	1044, 1046
Steiner Plastics Mfg. Co., Inc.	401, 403
W. L. Stensgaard and Associates, Inc.	212
Sterling, Inc.	614
F. J. Stokes Machine Co.	31, 125, 127, 131
Stokes Molded Products, Inc.	34
Stokes-Trenton, Inc.	307
M. Swift & Sons, Inc.	1043, 1045
Thermaflow Chemical Corp.	844
Thermel, Inc.	1205
Tracerlab, Inc.	1140
United States Gypsum Co.	1102, 1201
U. S. Industrial Chemicals Co., Div. of National Distillers Products Corp.	710
U. S. Royalite Div., U. S. Rubber Co.	1210, 1212
Vacuum Forming Corp.	1125
Vacuum Metalizing Corp.	704
Van Dorn Iron Works Co.	532
John Waldron Corp.	107
Wasco Products, Inc.	1208
Watson-Stillman Press Div., Farrel-Birmingham Co., Inc.	215, 219
Welding Engineers, Inc.	214, 216, 218
West Instrument Corp.	1131
Westchester Plastics, Inc.	1001, 1003
Westinghouse Electric Corp.	925
Westlake Plastics Co., Crystalx Corp.	309
Wheelabrator Corp.	316, 318
C. H. Whitlock Associates	735
Whyte Mfg. Co., Inc.	202
Edwin L. Wiegand Co.	940
Winner Mfg. Co., Inc.	943
Witco Chemical Co.	941
World Plastex	128

Only ENAMELSTRIP give

CERTIFIE

by th



These are just 7 of the basic tests on which Enamel has been granted Certification. Special tests are adde uses are encountered which require individual considerat

FLEXIBILITY

A test to determine the capacity of Enamelstrip coated faces to withstand the bending and shaping in nor manufacturing operations without cracking. This is an portant *quality control* feature for manufacturers. F bility tests were run under normal temperature, as wel under conditions of high temperature and high humi

SALT SPRAY

This test duplicates the action of normal corrosive eleme in the atmosphere; it is also useful in determining the e of sea water exposure on the surface tested. It is impor wherever the end-use product is to be used near swimm pools, beaches, or in general outdoor applications. E cially important for valuable equipment such as port radios, cameras, etc.

Enamelstrip pre-coated metal coil is pre-tested and cer fied for performance – your assurance that it will not o withstand the rigors of your production – but also meet exceed the special end-use requirements of the product y are manufacturing.

Enamelstrip takes the guesswork out of your bendi drawing, forming, piercing, blanking and stamping ope tions. It makes it possible for you to get all the economy a added production advantages that are made possible continuous pre-coated metal coil, with the added assura of continuous quality. The pre-tested quality of Enamelst enables you to set and maintain your product's performa standards at a pre-planned level.

Enamelstrip is available in a variety of metals a finishes, and is now being produced in the following b metals: cold rolled steel, tin mill black plate, electroly tin plate, electro-galvanized steel, aluminum, brass, copp and zinc. Our accurate custom slitting operation make possible for us to furnish you with Enamelstrip in widt ranging from 7/32" to 32". Enamelstrip can be made ava able in all gauges ranging from .005 to .035 (and heavi in aluminum).

Exacting and continuous control of the oven baked coatin applied makes possible the continuous quality and end-

CONTINUOUS PRE-COATED ENAMELSTRI

---

r

helps

up-to

and c

SE TH
POST-
TO RE

FREE
MANU
LITER

from
new
pages
Unde
you
listin
litera
refer
bulle
on t

INFO
ADV

will
you
code
with
and
care

WA
M

rea
for
Ma
rep
the
av
ha
or
av
pa

reader service

helps you get
up-to-date technical bulletins
and details on advertised products

SE THESE
POST-FREE CARDS
TO REQUEST . . .

FREE
MANUFACTURERS'
LITERATURE . . .

from the selected list of new bulletins reviewed on pages following this insert. Under subject headings, you will find a cumulative listing of current technical literature suitable for your reference files. To obtain bulletins, circle numbers on the card.

INFORMATION ON
ADVERTISED PRODUCTS

will be forwarded to you if you note the reader service code number appearing with the advertisement, and circle it on one of the cards at right.

WANT
M & M MANUALS?

reader service will fill requests for MATERIALS & METHODS Manuals. All Manuals are reprinted as they appear in the magazine and are available for a nominal handling charge. For an order blank and a list of available Manuals, see page 222.

June 1956

NAME ____________ POSITION ____________

FIRM ____________

STREET ____________ CITY ____________

STATE ____________

This card not good after August 1.

Manufacturers' Literature No. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80
81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110
111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140
141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170
171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200
201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230
231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260
261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290
291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320
321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350

Information on Advertisement No. 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380
381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410
411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440
441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470
471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500
501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530
531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560
561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590
591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620
621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650

Students and foreign subscribers (other than Canadian), please request literature directly from manufacturers.

MANUFACTURERS' LITERATURE

New Literature

Rubber-Metal Parts. Acushnet Process Co., 7 pp, illus. Use of Apcotite process for bonding natural and synthetic rubbers, including silicones, to metals. (1)

Fasteners. Albany Products Co., Inc. 28 pp, illus. Pocket-size catalog of standard fasteners—bolts, nuts, rivets, screws, washers. (2)

Cemented Carbides. Allegheny Ludlum Steel Corp. Four charts on carbide properties and other physical data. (3)

Aluminum, Stainless Steel. Aluminum Goods Mfg. Co., Contract Div., 21 pp, illus. "Service to Industry" lists wide variety of component parts made for government and industry. Technical services and finishing and fabricating facilities also described. (4)

Polyethylene, PVC. American Agi Corp. Illustrated catalog of polyethylene and polyvinyl chloride sheet, bar rods, blocks, moldings, weldments, a welding and spraying equipment. Al information on a powder fluidizer f coating small objects with polyethylene and other fusible powdered materials. (5)

Zinc. American Zinc Institute, Inc. 32 pp, illus. How metallic zinc coatings, pigments and anodes provide economical control of corrosion. (6)

Brazing. Ampco Metal Inc., 1 p, illus. Facts on Ampco-Braz, three-in-one filler rod for brazing, weld-brazing and overlaying. (7)

Greaseproof Wrap. Angier Corp., 2 pp, illus. Information on Super Induwrap, which uses Mylar as a greaseproof barrier. (8)

Iron Powders. Antara Chemicals Sales Div., General Aniline & Film Corp., 7 pp, graphs. Properties of types SF, J and the new W carbonyl iron powders. (9)

Corrosion Proof Materials. Atlas Mineral Products Co., 16 pp, No. CC-3. Chemical and physical data, estimating data and descriptions of products used for acid proof installations in the metal working, chemical, petroleum, pulp and paper and other industries. (10)

Vacuum Forming. Bakelite Co., Div. of Union Carbide & Carbon Corp. Latest issue of *Extruderitems* covers "Extrusion of High-Gloss, High-Impact Styrene for Vacuum Forming." (11)

Castings. Barnett Foundry & Machine Co., 75 pp, illus., No. 14. Describes metallurgy and interprets engineering properties of the various types of Meehanite metal and gives their applications in industry. (12)

Industrial Wire Cloth. Cambridge Wire Cloth Co., 4 pp, illus., No. 113. Information on industrial wire cloth, from 20 x 250 mesh up to 4-in. openings of any metal or alloy. (13)

Stainless Steel Wire. Carpenter Steel Co., Webb Wire Div., 6 pp, illus. Analyses, tensile strengths physical properties and gages of 12 types of stainless wire generally used in wire products. (14)

Molybdenum Disilicide. Climax Molybdenum Co. 10 pp, No. CH-23. Describes various techniques for making molybdenum disilicide parts: sintering and cold pressing, casting, vapor deposition and hot pressing. (15)

Self-Locking Fasteners. Continental Screw Co., leafllet, illus. Features Holtite-Nylok screws and bolts. Nylon inserts in threaded section provide smooth, positive locking action. (16)

Shell-Mold Castings. Crobalt, Inc., 2 pp, illus. No. 103. Production service on shell-mold castings; ferrous and nonferrous alloys handled; typical parts produced; size, accuracy and quality of castings. (17)

Perforated Steel Sheets. Cross Engineering Co., leaflet, illus. Shows variety of designs available and typical uses of perforated steel sheets for

FIRST CLASS
PERMIT NO. 1538
(SEC. 34.9 P.L.&R.)
NEW YORK, N. Y.

BUSINESS REPLY CARD
No Postage Stamp necessary if mailed in the United States

4¢ POSTAGE WILL BE PAID BY—
MANAGER, READER SERVICE DEPARTMENT

MATERIALS & METHODS
430 PARK AVENUE
NEW YORK 22, N. Y.

ventilation, concealment, decoration and protection. (18)

Silicone Lubricant. Dow Corning Corp., 1 p, illus. Information on 4X Compound, a nonmelting, nonfreezing and nongumming silicone lubricant used for rubber weather stripping, battery terminals, radio antennae and ignition systems. (19)

Radiography. E. I. du Pont de Nemours & Co., Inc., Photo Products Dept., 28 pp. Describes products for industrial radiography and gives exposure and processing data for various films used. (145)

Polyethylene Injection Molding. Eastman Chemical Products, Inc., 16 pp. Molding of Tenite polyethylene and suggestions for correcting molding difficulties. Melt casting, dipping, machining, welding, heat sealing and printing are discussed. (20)

Solid Film Lubricants. Electrofilm, Inc., 4 pp, illus. Where Electrofilm solid film lubricants should be used and how they reduce friction and increase wear life. (21)

Metal Joining. Eutectic Welding Alloys Corp., 16 pp, illus. How Low Temp EutecRods and Low Amp EutecTrodes minimize or completely eliminate residual stresses, cracking, warping and distortion of base metals. (22)

Laminated Plastic. Formica Co., 4 pp, illus. Uses of S-52 laminated plastic forming material for nonferrous metals, plastics, wood, rubber, vulcanized fibre and other materials. Made from a paper base impregnated with phenolic resin, it is used for aviation and automotive tooling. (23)

Tooling Resins. Furane Plastics, Inc., No. EP-56-98. Chart listing basic information required in the selection of epoxy resins for tooling, casting, laminating and gel coating purposes. (24)

Synthetic Rubber. Firestone Tire & Rubber Co., Synthetic Rubber & Latex Div. Information on FR-S, a new synthetic rubber developed by improved techniques, new measuring devices, and scientific methods of control. (25)

Irradiated Polyethylene Film. General Electric Chemical Development Dept., 15 pp, illus. Technical report on Irrathene, an irradiated polyethylene film of interest to the electrical and packaging industries and to others who desire a nonmelting polyethylene film. (26)

Slip-Proofing. Hallemite Mfg. Co., 4 pp, illus. Information on an industrial grip material that makes interior or exterior surfaces slip-proof and skidproof even under wet or oily conditions. (27)

Brazing. Handy & Harman, 4 pp, illus., No. 11-A. Why Easy-Flo is favored for carbide tipping. Also recommended procedures for brazing high speed tool tips. (28)

Welders. Harnischfeger Corp., 2 pp, illus., No. W-103. Double duty a.c.-h.f. welders for metallic arc or Heliarc welding. (29)

Steel Extrusions. H. M. Harper Co., 16 pp, illus. Covers production of extrusions from stainless steels, heat resistant alloys, titanium, alloy steels, carbon steels and specialty bronzes. Glass lubricant assures inexpensive dies, rapid die changes and economical extrusion of difficult alloys. (30)

Screens, Fabricated Metals. Hendrick Mfg. Co., 132 pp, illus. A 75th anniversary catalog on perforated metals, screens and fabricated metals. Typical uses, designs, sizes and engineering data. (31)

Indium Alloys. Indium Corp. of America, 93 pp, graphs. "Constitution of Indium Alloy Systems" by E. A. Peretti, head, Dept. of Metallurgy Notre Dame Univ. (32)

Cast Iron Parts. International Nickel Co., Inc., 4 pp, illus. "The Repair of Cast Iron Parts" contains nine graphic case histories showing Ni-Rod and Ni-Rod 55 welding electrodes in action. (33)

Printed Circuit Laminates. International Resistance Co., 2 pp, graphs, No. AR-2a. Fluorocarbon plastic for printed circuitry. Data on proposed types, design considerations, chemical and electrical properties, and properties of metal-clad laminate. (34)

Electrical Tapes. Johns-Manville Sales Corp., Dutch Brand Div., 11 pp, illus. Characteristics and performance specifications for plastics, friction, rubber and vinyl color electrical tapes. (35)

Glass Fiber Roving. L.O.F. Glass Fibers Co., 8 pp, illus., No. TPL 1. Describes Garan-, Vitron- and chrome-sized roving for rod stock, molding compounds, preforming mat, woven roving and other uses. (36)

Wire Strippers. London Chemical Co., Inc., 4 pp, illus. Acid organic type chemical wire strippers that strip any magnet wire at room temperature on a production basis. (37)

Copper Tubing. Mackenzie Walton Co., 4 pp, illus. Facilities for producing precision nonferrous seamless tubing, particularly capillary, Bourdon, thin wall, braided and shape tubing. (38)

Coatings, Adhesives. Magic Chemical Co. Catalog of Magic-Vulc protective coatings and Peerless industrial adhesives. (39)

Corrosion Prevention. Metallizing Engineering Co., Inc., 4 pp, illus. Description of Metco Systems and how these pure metallized zinc or aluminum coatings prevent corrosion. Typical applications shown. (40)

Rubber Linings. Metalweld, Inc., Protective Coating Div., 8 pp, illus. Advantages and applications of rubber linings in steel tanks, drums, pipes, valves, fittings and pumps. (41)

Adhesives, Coatings, Seals. Minnesota Mining & Mfg. Co., Adhesives & Coating Div., 4 pp, illus. Eleven applications of six different types of 3M adhesives, coatings and seals show how they are used in the truck and bus industry to make equipment watertight, attractive and comfortable. (42)

Forgings. Mueller Brass Co., 33 pp, illus. Brass, bronze and aluminum forgings. Chemical, mechanical and physical properties of forging alloys, forging procedures, design factors and machining. (43)

Test Equipment. Murphy & Miller, Inc., 16 pp, illus. Performance and operating data on equipment for laboratory or production testing. (44)

Hex Nuts. National Machine Products Co., 24 pp, illus. Data on hex nuts and other fasteners. Also a guide chart for calculating wrench torques. (45)

Protective Coatings. Nukem Products Corp., 8 pp, illus. How Nukemite No. 24, a styrene-butadiene copolymer coating, and Nukemite No. 33 and No. 40, vinyl-copolymer coatings, provide "the highest degree of corrosion resistance" without sacrificing color appeal. (46)

Paint Stripping. Oakite Products, Inc., 14 pp, illus. Procedures followed in four different stripping methods: steam gun, hot flow-on, cold spray and tank. Also how to protect stripped parts in storage and how to prepare them for repainting. (47)

Cartridge Fastener. Olin Mathieson Chemical Corp., Ramset Fastening System. Two booklets on the Duo-Jobmaster that uses a cartridge to set a fastener into concrete, steel and other hard-to-penetrate materials in a fraction of the time usually required. (48)

Thin Metal Strip. Penn Precision Products, Inc., 8 pp, No. 7. Case histories and data on thin gage (down to 0.5 mil) beryllium copper, phosphor bronze, nickel silver, chromium copper, stainless 17-7PH, invar and magnetic alloy strip. (49)

Irradiation Effects. Penn-Texas Corp., Nuclear Engineering Div. "Effect of Irradiation on Solid Materials," a bibliography containing more than 300 titles. (50)

Glassed Steel. Pfaudler Co., 8 pp, illus., No. 928. Five charts show corrosion resistance of Pfaudler glassed steel to nitric, acetic, sulfuric, hydrochloric and phosphoric acid solutions. (51)

Ferromagnetic Plastic. Polypenco Products, Polymer Corp., 13 pp, graphs. Ferrotron, ferromagnetic plastic, is expected to open new fields of design in electronics. Available in rigid magnetic cores and flexible rod and tape, it has good magnetic and dielectric properties and good flexibility. (52)

Sealing Compounds. Presstite Engineering Co. Pictures and captions show many sealing compound applications, including watertight sealing of automobile drip rails, moisture-proofing of refrigerator heater wire assemblies, and cope and drag sealing for foundry casting. (53)

Metal Finishing. Promat Div., Poor & Co., 4 pp, illus. Explains Pre-Galv process of controlling galvanizing operations by use of only one addition to each of the pickle and flux operations. Result is superior, controlled galvanizing, longer acid life, con-

Manufacturers' Literature

trolled dross formation and improved appearance. (54)

Silver Cloth Tape. Permacel Tape Corp. Brochure describes how silver cloth tape aids in duct installation. Water and moisture resistant, it provides an effective seal against air leaks and dust. (55)

Conversion Coatings. J. W. Rex Co., 12 pp. Describes anodized, Alodized and various other types of conversion coatings obtainable on aluminum, magnesium or steel. (66)

Cushioning Materials. Rubatex Div., Great American Industries, Inc., 24 pp, illus. Contains a sample of Rubatex vinyl foam and shows typical applications. (56)

Precision Molded Parts. Raybestos-Manhattan, Inc., Equipment Sales Div., 16 pp, illus., No. 550. Precision molded products for automotive, industrial, household appliance and special applications. Covers design data, machinability and dies. (57)

Industrial Chemicals. Swift Industrial Chemical Co. Data sheets and information on heat treating salts, black oxide compounds, metal cleaning compounds, rust resisting oils, quenching oils and other industrial chemical products. (58)

Aluminum Hard-Surfacing. Tiarco Corp., 4 pp, illus. Explains Hardalume process, a new technique for providing a surface layer of hard chromium on aluminum. Chromium, though heavy, hard and dense, is ductile, and bond between chromium layer and underlying aluminum is stronger than has been attained previously. (59)

Wire Construction. E. H. Titchener & Co., 17 pp, illus. Detailed information and engineering data on use of wire construction in product design. Case histories give examples of cost savings achieved. (60)

Seamless Tubing. Tube Reducing Corp., 15 pp, illus., No. R 2. Advantages and savings in using Rockrite close tolerance, cold reduced seamless tubing. (61)

Paint Bond Coating. Turco Products, Inc., 4 pp. Explains benefits of Turcoating process which puts a chemical coating on metals before painting. Other uses include anti-friction coating rust removal, cleaning and passivation. (62)

Coatings. Union Tool Corp., 6 pp, illus. Covers roller coatings used for wood, metal, paper, plastics, cork, fabric, rubber, veneer and cardboard. Specifications and on-the-job applications. (63)

Cored Forgings. Weatherhead Co., Aviation Div., 6 pp, illus., No. AB 1001. Advantages of cored forgings of aluminum and other nonferrous metals, including finer grain structure, far less flash, close tolerances and high strength. (64)

Extruded Plastics. Western Textile Products Co., Extruded Plastics Div., 4 pp, illus. Describes company experience and shows special problems solved. (65)

Stainless Steel Fabrication. Crucible Steel Co. of America 160 pp. Fabricator's handbook for Rezistal stainless steels. Forming, machining, cutting, joining, heat treating, pickling, finishing and reference data. (80)

Metal Stampings. Dayton Rogers Mfg. Co., 8 pp, illus. Stamped metal parts available, cost data and company's services. (39)

Rings. Dresser Mfg. Div., Dresser Industries Inc., 4 pp, illus. Heavy industrial equipment fabrication from welded rings. (81)

Iron Powders. Antara Chemicals Div., General Aniline & Film Corp., 31 pp, illus. Properties of carbonyl iron powders. Tables and charts. (82)

Stainless Steel Welding. General Electric Co., 8 pp, illus., No. GET-1955. Presents a variety of welding and metallurgical applications of stainless steels. (83)

Sponge Iron Powders. Hoeganaes Sponge Iron Corp., 6 pp, illus. Outlines principles of powder metallurgy and shows role of sponge iron powder in this process. (84)

Machine Part Castings. Hunt-Spiller Mfg. Corp., 20 pp, illus. Gun iron castings of 100% pearlitic microstructure. (85)

Sheet and Plate Fabrication. Kirk & Blum Mfg. Co., 38 pp, illus. Describes facilities and equipment used in production of metal sheet and plate. (86)

Stainless Steel Castings. Kolcast Industries, Inc., 4 pp, illus. Large stainless steel precision castings made by the frozen mercury process. (87)

Stampings. Laminated Shim Co., Stampings Div., 12 pp, illus. Facilities for producing quality stampings to specifications and ordering data. (88)

Wire Gage Chart. Little Falls Alloys, Inc. Chart for determining gage and footage readings in Brown & Sharp (A.W.G.) wire gages. (89)

Ductile Iron Castings. Lynchburg Foundry Co., 12 pp, illus. Describes ductile cast iron with detailed description of its properties, and suggests applications. (90)

Welded Assemblies. R. C. Mahon Co., 1 p, illus. Several examples show the capabilities of welding for construction of various assemblies. (91)

Metal Powder Parts. Metal Powder Products, Inc., 4 pp, illus. Shows the variety of applications for iron, iron-copper and bronze sinterings made by this company. (92)

NSMPA 1955-56 Buying Directory. National Screw Machine Products Assn., 74 pp. Lists more than 270 firms alphabetically and geographically. Also gives conditions of sale and manufacturing practices for screw machine products. (93)

Wire Cloth. Newark Wire Cloth Co., 8 pp, illus. Wire cloth and screening offered in all metals and all weaves and as fabricated parts. (94)

Special Shaped Alloy Wire. Alloy Metal Wire Div., H. K. Porter Co., 4 pp, illus, No. T-2. Describes special shaped alloy wire and tabulates properties. (95)

Other Available Literature

Irons and Steels • Parts • Forms

Malleable Iron. Albion Malleable Iron Co., 15 pp, illus. A thorough analysis of malleable iron for casting, the booklet contains a definition of malleable iron, its relationships to other ferrous materials, micrographs, physical properties and relative cost figures for several parts now being manufactured. (67)

Stainless Fasteners. American Screw Co., 7 pp. Gives physical properties and applications. Describes cold heading and other fabricating techniques. (68)

Stainless Steel Fastenings. Anti-Corrosive Metal Products Co., Inc., 64 pp. Catalogs more than 9,000 stainless steel fastenings and gives price lists and discount sheets. (69)

Precision Castings. Austenal Laboratories, Inc., Microcast Div., 16 pp, illus. Describes Microcast Process for manufacture of precision cast parts, including specifications and explanation. (70)

Steel Tubing. Avon Tube Div., 8 pp, illus. Fabrication and application data for thin-walled steel tubing. **(71)**

Steel Tubing. Babcock & Wilcox Co., 8 pp, illus, No. TB-408. Lists types of tubing available, and tabulates properties of 20 steels ranging from carbon to stainless. (72)

Low Alloy Steel. Bethlehem Steel Co., 66 pp, illus, No. 353. Properties and features of Mayari-R steel for use in applications requiring high strength and good wear and corrosion resistance. (73)

Iron and Steel Castings. Campbell, Wyant & Cannon Foundry Co., 24 pp, illus. Describes types of gray iron and steel castings. (74)

Alloy Comparison Chart. Cannon-Muskegon Co. Comparison chart of AISI, SEA, ACI, AMS, WAD, PWA alloy specifications. (75)

Stainless Tubing. Carpenter Steel Co., 28 pp, illus. Contains corrosion resistance tables, charts and test results for stainless tubing and pipe. (76)

Weldments. Cleveland Welding Co. Illustrated brochure describes special process of radial welding of circular steel parts. (77)

Steel Sheets and Wire. Continental Steel Corp., 20 pp, illus. Contains sizes, tempers, shapes and finishes of wire available and describes types of steel sheet in stock. (78)

Lead Treated Steel. Copperweld Steel Co., Steel Div., 8 pp, illus. Mechanical properties and applications of lead treated steels. **(79)**

Manufacturers' Literature

Preformed Metal. Rigidized Metals Corp., Pattern selector guide for preformed metals. (96)

Steel Tubing. Rochester Products Div., General Motors Corp., 12 pp, illus, No. 271. Typical applications of GM tubing made in both single and double walls of steel. (97)

Foundry Products. Superior Steel & Malleable Castings Co., 25 pp, illus. Gives 25 case histories showing products before and after re-designing. (98)

Spun Metal Parts. Spincraft, Inc., No. 3. Metal spinning and fabricating. Data on process and help in designing for economical production. (99)

Weldments. Van Dorn Iron Works Co., 10 pp, illus. Company facilities for producing weldments and other parts in all sizes. Examples show type of work done. (100)

Steel Strip. Weirton Steel Co., 20 pp, illus. Characteristics of electrolytic zinc-coated sheets and strip, high-tensile steel and high carbon strip cold-rolled spring steel manufactured by Weirton. (101)

Metal Stamping. Worcester Pressed Steel Co., 8 pp, illus. Company facilities for custom metal stamping. (102)

Cold Finished Steels. Wyckoff Steel Co., 87 pp. Handbook gives basic engineering data on cold finished steels. Includes numerous tables of properties and specifications. (103)

Nonferrous Metals • Parts • Forms

Aluminum Applications. Aluminum Co. of America, 80 pp, illus. Process applications of aluminum; performance of aluminum with various chemicals; information on designing aluminum processing equipment. (104)

Wear Resistant Materials. American Brake Shoe Co., 48 pp, illus. Catalog of representative products; castings, bearing materials, forgings, sintered metals and industrial equipment. (105)

Bronze Casting Alloys. American Manganese Bronze Co., 50 pp, illus. Revised edition gives composition, characteristics and applications of the principal copper alloys used to make castings. (106)

Magnesium and Aluminum Alloy Castings. Bendix Foundries, 4 pp. Facilities for sand, die, shell, plaster and permanent mold castings of magnesium or aluminum. (107)

Magnesium-Thorium Alloy. Brooks & Perkins, Inc., 28 pp. Design data on the new temperature resisting magnesium alloy, HK-31. Graphs and charts. (108)

Machining Titanium. Cincinnati Milling Machine Co., 16 pp, illus., No. M-1866. Discusses machining characteristics with emphasis on chip formation. (109)

Metal Laminate. Columbus Coated Fabrics Corp., 12 pp, illus. Describes Col-O-Vin, a semi-rigid vinyl sheeting which can be bonded to steel or nonferrous metals. Samples included. (110)

Extrusions and Castings. Metals Processing Div., Curtiss-Wright Corp., 2 bulletins, 8 pp each, illus. Bulletins describe method of extruding metals and the technique of casting top quality parts. (111)

Die Castings. Dollin Corp., 16 pp, illus. Booklet describes plant and facilities for die castings. (112)

Titanium. E. I. du Pont de Nemours & Co., Inc., 8 pp, illus. Up-to-date data on properties of titanium and methods of fabricating the metal. (113)

Bonded Bi-Metallics. Fairchild Engine & Airplane Corp., 4 pp, illus. News of Al-Fin process and its application to a variety of fields. (114)

High Density Metal. Fansteel Metallurgical Corp., 16 pp, illus. Properties and uses of Fansteel 77 Metal. This machinable tungsten-copper-nickel alloy, 50% heavier than lead, is used for counterweights, flywheels, vibration damping and radiation shielding devices. (115)

Aluminum Bronzes. W. W. Alloys, Inc., Div. of Fansteel Metallurgical Corp., 28 pp, illus., No. 15.100-1. Detailed information on aluminum bronzes. Physical properties and typical applications. (117)

Aluminum Alloy. Frontier Bronze Corp., 24 pp, illus. Describes Alloy "40-E", a high strength alloy containing zinc with magnesium, titanium and chromium, which needs no heat treatment. Separate data sheets on specifications, composition and properties. (118)

Zinc Die Castings. Gries Reproducer Corp., 8 pp, illus. Design information and properties of zinc alloys for die casting. (119)

Brass. Hampden Brass & Aluminum Co., 262 Liberty St., Springfield, Mass., 24 pp, illus. Describes manufacturing facilities of the company and of the Fibermold Div. which makes reinforced plastics. Request from Hampden on company letterhead.

Powder Metallurgy. Harper Electric Furnace Corp. Bibliography of periodical references to powder metallurgy. Covers nearly 250 articles printed in 1954 and 1955 in the U.S., England and Canada. (120)

Perforated Materials. Harrington & King Perforating Co., 8 pp, illus., No. 62. A handy thumb index catalog illustrating different standard patterns and giving information on hole size, centers and percent of open area. (121)

Aluminum Products. Harvey Aluminum, 8 pp, illus. Describes wrought aluminum products and gives engineering and design data. (122)

Laminated Metals. Improved Seamless Wire Co., Inc., 6 pp, illus. Describes the importance and applications of laminated metals to modern industry. (123)

Small Tubing. Mackenzie Walton Co., 25 pp. Size ranges of precision seamless tubing in copper and copper-base alloys available. (124)

To obtain literature listed on these pages, use the convenient prepaid post card on pp 71 and 72.

Tin. Malayan Tin Bureau. "Tin News," a monthly publication of the Malayan Tin Bureau, reviews market situation, tin uses and political developments affecting tin supply. (125)

Titanium. Metal Hydrides, Inc., 2 pp, No. 600-C. Data sheet on titanium metal and facts on storage and handling. (126)

Thermostat Metal. General Plate Div., Metals and Controls Corp. Information on selecting thermal elements and their design. Tables give major mechanical and physical constants for various thermostatic metals. (127)

Aluminum Core. Narmco Metlbond Co., 6 pp. Formable core material for aluminum sandwich constructions where application requires small radius curves. (128)

Die Castings. National Die Casting Co., 8 pp, illus., No. 266. Describes die casting facilities. Data sheet on zinc and aluminum die casting alloys. (129)

Electrolytic Nickel Powder. National Radiator Co., Plastic Metals Div. Specifications Sheets Nos. PMS 30, 31, 32, 33 and 34. Lists chemical and physical properties of five grades of electrolytic nickel powder. (130)

Aluminum Castings. Permold Co., illus. Shows how continuous scientific control of Permold aluminum casting quality, to specifications, saves time and money. (131)

Aluminum Extrusions. Precision Extrusions, 12 pp, illus. Describes aluminum extrusion process with tables of physical properties and recommended applications. (132)

Titanium. Rem-Cru Titanium Inc., 12 pp. Data sheet on Rem-Cru C-130AM. (133)

Spun and Formed Shapes. Roland Teiner Co., Inc., 5 pp. Hydroforming and spinforming of fabrications of all sizes. (134)

Aluminum, Magnesium Castings. Rolle Mfg. Co., 58 pp, illus. Guide to design and specifications of aluminum and magnesium, sand, permanent mold and die castings. Discusses advantages and disadvantages of casting methods and gives properties of common aluminum magnesium casting alloys. (135)

Aluminum Strip. Scovill Mfg. Co., 20 pp, illus. Physical characteristics, temperature designations, weights and fabricating data for aluminum alloy strip. (136)

Small Wire. Secon Metals Corp., 2 pp. Research on and development and production of small precision wire. (137)

Stamping and Perforating. Standard Stamping & Perforating Co., 114 pp, illus. Catalog of standard stamped and perforated patterns. (138)

Shaped Tubing. Superior Tube Co., 3 pp, illus., No. 17. Shapes and analyses available (stainless, carbon nickel and nickel alloys, glass sealing alloys, titanium, and beryllium copper), tool charges, size range, commercial tolerances, lengths, temper, and how to order. (139)

Brass Pressure Die Castings. Titan Metal Mfg. Co., 4 pp, illus. Outlines economical uses of brass pressure die castings as fabricated assembly parts. (140)

Manufacturers' Literature

Electronic Materials. Tungsten & Chemical Div., Sylvania Electric Products, Inc. Series of data sheets on tungsten, molybdenum, semiconductor, plated wire, chemical and phosphor products. (141)

Precision Impellers. Universal Castings Co., 4 pp, illus. Technique of pouring at low temperatures and applied vacuum described for casting precision impellers. (142)

Super Alloys. Universal-Cyclops Steel Corp., 20 pp, illus. High-strength, corrosion resistant alloys for gas turbines, turbo-superchargers, rockets and guided missiles. (143)

Stampings. Variety Machine & Stamping Co., 4 pp, illus. Describes plant facilities and types of stampings produced. (144)

Thermometals and Special Alloys. H. A. Wilson Co., 2655 U. S. Route 22, Union, N. J., 192 pp, price $3.00. New Blue Book on thermostatic bimetals, sintered metals, electrical contact materials, composite and laminated metals and special alloys. Provides design data, graphs, formulae and properties and applications of hundreds of materials. Also lists production executives, purchasing agents in the field. Request from Wilson on company letterhead.

Nonmetallic Materials • Parts • Forms

Wool Felt. American Felt Co. Includes Dept. of Commerce bulletin Commercial Standard 185-52 Wool Felt. 47 reference samples of industrial felts. (146)

Electrical Insulators. American Lava Corp., 14 pp, No. 546. Catalog of company's available stock of high frequency electrical insulators meeting JAN-1-8 specifications. (147)

Extruded Plastics. Anchor Plastics Co. 12 pp, illus. Applications of thermoplastic rods, tubes and shapes. Summary of properties of plastics materials with usage table. (148)

Fiberglass Reinforced Plastics. Apex Electrical Mfg. Co., 4 pp, illus. Case histories of custom molded fiberglass parts featuring pressure vessels. (149)

Gasket Materials. Armstrong Cork Co., 24 pp, illus. Complete data on various cork and rubber gasket materials made to meet government specifications. (150)

Resin-Bonded Laminates. Chemical Corp., 20 pp, illus., No. PD-1R353. Data sheets on a variety of tanks, ducts, hoods, stacks and waste pipe for corrosion resistant use. (151)

Compounded Elastomers. Chicago Rawhide Mfg. Co., 32 pp, illus. Characteristics, properties and engineering applications of Sirvene compounded elastomers. (152)

Contact Pressure Laminating Resins. Ciba Co., Inc., 17 pp, No. 1. Technical data on Araldite contact pressure laminating resins. Includes technical and electrical properties, charts and tables, mold preparation, glass fiber reinforcement and manufacturing procedures. (153)

Fiberglass Reinforced Parts. Clearfield Plastics, Inc., 22 pp, illus. Facilities for producing molded contoured parts. Suggests design and specification techniques. (154)

Vacuum Forming. Coating Products, 2 pp, illus. Bulletin on vacuum forming method of molding thermoplastic sheets. (155)

Pipe and Fittings. Colonial Plastics Mfg. Co. Series of bulletins describing pipes and fittings made of rigid unplasticized polyvinyl chloride. Also data on valves. (160)

Bolt and Forging Products. Columbus Bolt & Forging Co., 40 pp, illus. Describes facilities for producing assembly parts for the bolt and forging industries. (161)

Extruded Plastics, Rubber. Conneaut Rubber and Plastics Co., 4 pp, illus., No. CR-53. Die making and production facilities of rubber and plastic extrusions. (162)

Molded and Extruded Rubber. Continental Rubber Works, 8 pp, No. 100. Dimensions of molded and extruded rubber with cross sectional illustrations. Also condensed SAE and ASTM specification chart. (163)

Teflon Gaskets, Packing. Crane Packing Co., 12 pp, illus., No. T-103. Data on Chemlon packings and gaskets fabricated from the new tetrafluoroethylene resin, Teflon. (164)

Foamed Styrene. Dow Chemical Co., 25 pp, illus. Properties of Styrofoam, an expanded polystyrene for structural insulation at low temperatures. (165)

Custom Laminations, Extrusions. Dobeckmun Co., 4 pp, illus. Describes facilities for custom laminations of customers' materials or specialized conversion of films, foils and papers for applications such as pipe wraps, duct facing, polyethylene coated cloth. (166)

Vinyl Foam. Elastomer Chemical Corp., 14 pp, illus. Characteristics and uses of vinyl foam discussed in terms of successful applications. (167)

Teflon. Ethylene Chemical Corp., 8 pp, illus. Complete data on a variety of molded and extruded Teflon parts, sheets, rods and tubing. Includes table of properties. (168)

Ceramics. Frenchtown Porcelain Co., 7 pp, illus., No. 955. Quality control and interior production methods are pictured and a properties chart is included. (169)

Electrical Insulating Materials. General Electric Co., 8 pp, illus. Lists insulating materials, including varnishes, finishes and mica mat. Properties and applications given. (170)

Polyvinyl Chloride Resin. General Tire & Rubber Co., Chemical Div. Illustrated folder on polyvinyl chloride resin for calendering, extruding and molding operations. (171)

Coated Fabric. Textileather Div., General Tire & Rubber Co., 6 pp, illus. Introduces Nygen Tolex and nylon reinforced coated fabrics. (172)

To obtain literature listed on these pages, use the convenient prepaid post card on pp 71 and 72.

Glass Reinforced Plastic. Glastic Corp., 2 pp. Data on fiber glass reinforced polyester laminate sheets. (173)

Ceramic Bodies. Centralab Div., Globe Union, Inc., 28 pp, illus., No. 720-10M. Comprehensive survey of this firm's ceramic production. Includes description of engineering properties of ceramics, design information, allowable tolerances, and indicates broad scope of ceramic products with data dimensions. (174)

Latices for Textiles. B. F. Goodrich Chemical Co., 16 pp. Service bulletin on use of Hycar latices in textiles. Includes chart showing physical properties of Hycar latices in typical fields of application. (175)

Custom Made Rubber Parts. Goshen Rubber Co., Inc., 8 pp, illus. Representative products, fabricating operations and development of compounds. (176)

Plastics. Heil Process Equipment Corp., 4 pp, illus., Vol. 4, No. 1. Suggests applications for Rigidon, a glass-reinforced plastic; Rigidin, a rigid vinyl plastic; and Rigidene, a polyethylene plastic. (177)

Polyester Resins. Hooker Electrochemical Co. Data sheets on fire resistant polyester resins. (178)

Industrial Tape. Industrial Tape Div., Seamless Rubber Co., 60 pp, illus. Industrial tape catalog lists properties and pictures various types of tape. Includes breakdown of tape use in specific industries. (179)

New Polyethylene. Koppers Co., Inc., 16 pp, illus. Properties and uses of Super Dylan polyethylene, a tough, strong thermoplastic that will withstand sterilization temperatures. (181)

Glass. Lancaster Lens Co., 8 pp, illus. Twenty-one case histories of a wide variety of glass part applications. (182)

High-Impact Thermoplastic Resin. Marbon Corp., 20 pp, No. CY-2. Processing recommendations, physical data, chemical resistance data and results of aging tests for Cycolac, a new resinous polymer in which the basic material is styrene. (183)

Reinforced Wood. Met-L-Wood Corp., 15 pp, illus, No. 521. Describes combined wood and metal sheets, providing light weight and high strength. (184)

Adhesives and Sealers. Adhesives & Coatings Div., Minnesota Mining & Mfg. Co., 8 pp, illus. Describes adhesives, coatings, and sealers for the railroad industry and lists 23 typical applications. (185)

Glass Reinforced Plastics. Molded Fiberglass Co., 6 pp, illus. Facilities for producing glass fiber reinforced plastics molding. (186)

Carbon Specialties. Morganite, Inc., 12 pp, illus. Design data reference for carbon specialties, including chemical and physical properties, and typical blank sizes and parts. (187)

Boron Carbide. Norton Co., 16 pp, illus. A handbook on boron carbide, elemental boron, and other stable, boron-rich materials. (188)

Manufacturers' Literature

Fiberglass. Pittsburgh Plate Glass Co., 4 pp, illus. Lists advantages of using glass fiber for sound and heat insulation applications. (189)

Molding Compounds. Plumb Chemical Corp., 6 pp, illus. Data sheets on Fibercore molding compounds. Includes product applications and price lists. (190)

Industrial Tape. Polyken Products, 4 pp. Sixteen pressure-sensitive tape samples with accompanying specifications and properties. Explains basic industrial tape applications. (191)

Corrosion Resistant Gasketing. Products Research Co., 5 pp, illus. Features advantages and specifications of Chromelock corrosion resistant gasketing material. (192)

Asbestos-Reinforced Plastics. Raybestos-Manhattan, Inc., 46 pp, illus., No. T-55. Comprehensive analysis of asbestos cloths, felts and papers containing varying percentages of asbestos and glass fibers for use as reinforcement in both high and low pressure plastics laminates. Charts full range of engineering properties of asbestos materials and of high and low pressure laminates with various specific resins. (193)

Plastics Fabrication. Regal Plastic Co., 4 pp, illus. Custom contract service from designing and enginering to finished part, assembly or product—using plastic sheets, rods, tubes, reinforced fiberglass. Includes special bulletin on cases. (194)

Polyester Resins. Reichhold Chemicals, Inc. Brochure includes 11 technical bulletins two to six pages long describing the Polylite line of liquid thermosetting polyester resins. Bulletins cover molding characteristics and physical properties of ten resins of various heat and light resistant grades, suitable for use in glass fiber reinforced applications. (195)

Tooling Plastics. Ren Plastics, Inc., 4 pp, illus., No. 1001. Describes dimensionally stable tooling plastic for use in laminating or casting without application of heat or pressure. (196)

Plastics Hose. Resistoflex Corp., 4 pp. Flexible hose, assemblies and plastics products for heat and chemical resistant applications. (197)

Molded Plastics. Richardson Co., 12 pp, illus. Describes types and grades of laminated and molded plastics. Applications given. (198)

Gasket Sheeting. Rogers Corp., 4 pp, illus. Describes a line of asbestos-elastomer material. (199)

Rigid Polyvinyl Chloride. Seiberling Rubber Co., 11 pp. Data on corrosion resistance, physical properties and ways of using polyvinyl chloride. (200)

Plastics Moldings. Sinko Mfg. & Tool Co., 4 pp, illus. Facilities for producing molded parts and products. Automatic injection molding machines have capacities ranging from 4 to 60 oz. (201)

Fibre Products. Spaulding Fibre Co., 16 pp. Detailed breakdown of industry applications for vulcanized fibre and laminated phenolic plastics. (202)

Reinforced Plastics. Strick Plastics Corp., 4 pp. illus. Describes reinforced polyester laminate with good thermal, electrical, chemical and mechanical properties. Typical applications given. (203)

Rubber. Sun Rubber Co., 22 pp, illus. Facilities for processing, curing and finishing rubber products. (204)

Laminated Plastics. Synthane Corp., 4 pp, illus. Military government and other specifications of Synthane laminated plastics sheets, tubes and rods. (205)

Fabricating Laminated Plastics. Taylor Fibre Co., 15 pp. Reprints of NEMA-authorized enginering information, "Recommended Practice for Fabricating Laminated Plastics." (206)

Nylon-Lined Bearings. Thomson Industries, Inc., 5 pp. Metal bearing case with nylon liner extends service properties of nylon as bearing material. (207)

Thermoplastics. Westchester Plastics Inc., 4 pp. Advantages of using this company's services for all types of coloring in molding and extruding of plastics. (208)

Synthetic Rubber Products. Western Felt Works, Acadia Synthetic Products Div., 6 pp, illus. Describes various types of molded, extruded, roll die cut and lathe cut synthetic rubber parts and sheets. (209)

Laminated Plastics. Westinghouse Electric Corp., 50 pp. Catalog on industrial Micarta covering all grades and forms in which Micarta is supplied, and the chemical, mechanical and electrical properties of each. Machining data gives fabrication information. (210)

Stabilizing Vinyl Resins. Witco Chemical Co., 24 pp. Discusses various types of stabilizers and analyzes factors involved in individual stabilizing problems. (211)

Sealing Design. Franklin C. Wolfe Co., Inc., 4 pp, illus. Describes facilities and products for sealing bolts, studs, rivets and flanges. (212)

Finishes • Finishes and Cleaning

Resins for Paints. Barrett Div., Allied Chemical & Dye Corp., 8 pp. Plaskon coating resins for paints, varnishes, lacquers and allied products. (213)

Molybdenum Disulfide Lubricant. Alpha Corp., 4 pp, illus. Reprint discusses the properties and uses of pure molybdenum disulfide as a lubricant. (214)

Metal Protection, Paint Bonding. American Chemical Paint Co., 4 pp, illus., No. 3d/Am. Protective inorganic finishes to improve paint adhesion, corrosion resistance and facilitate metal forming operations. (215)

Plastics Finish. John L. Armitage & Co., 8 pp. Information on Armorhide, a textured plastics finish resembling leather. (216)

Protective Coatings. Ceilcote Co., 8 pp, illus., No. C-150. Base formulations, chemical properties and adhesion characteristics of seven standard organic coatings. Includes simplified chart for selecting coatings, surface treatment and processes. (217)

Aluminum Surface Treatment. Conversion Chemical Corp., Fact Sheet F-1. Describes chrome sealer films for treating aluminum. Film increases electrical properties of aluminum and also forms a good base for painting. (218)

Chromium Plating. Dawson Corp. Illustrated folder describes packaged chromium plating plant designed for precision control of dimensional build-up or salvage of wear components, tools and gages. (219)

Zinc Phosphate Coatings. Detrex Corp., 8 pp, illus. Phosphate coatings for protection of paint finishes under severe corrosion conditions. (220)

Black Oxide Finish. Du-Lite Chemical Corp. Information on Du-Lite finishes for any steel blackening problem. Also information on Du-Lite cleaner, strippers and burnishing compounds. (221)

Chemical Plating. General American Transportation Corp. Large illustrated folder. Describes Kanigen, a nickel plating process that does not require electrical equipment. (222)

Paint Finish for Metal. Glidden Co., 20 pp, illus. Displays application of Nubelite, an industrial paint finish for any metal product. (223)

Adhesives and Coatings. Houghton Laboratories, Inc., 96 pp. Bound volume of technical bulletins and price lists covering adhesives, coatings and plastics materials. (224)

Cleaning Tanks. Kelite Products, Inc., 2 pp, illus., No. 130-357R01. Hot and cold cleaning tanks for immersion cleaning or processing. (225)

Bright Copper Plating. Lea Mfg. Co., 22 pp. Technical manual on plating operations for bright copper coatings. Bath compositions and operating conditions given. (226)

Colored Silicone Finishes. Midland Industrial Finishes Co., illus. An interesting discussion of the application of colored silicone finishes. (227)

Aluminum-Chromium Paint. Monroe Co., Inc., 4 pp, illus., No. C-54-8. Includes detailed application data on Monco-Alochrom, an aluminum-chromium paint for exterior and interior surfaces of all kinds. (228)

Stripper. Northwest Chemical Co., 1 p. A liquid stripper to remove organic finishes from plastics, particularly imperfect articles. (229)

Lubrication. Parker Rust Proof Co., 12 pp, illus. How Parco Lubrite reduces wear on bearing surfaces. (230)

Phosphate Coating. Pennsylvania Salt Mfg. Co., 5 pp, illus. Description of the Fosbond process for producing phosphate coatings. (231)

Fluorocarbon Resin Coatings. Permolite, Inc., two 4-page bulletins. Fluor-O-Alloy coatings based in trifluorochloroethylene polymer. Includes corrosion resistance data and application data. (232)

Industrial Brushes. Pittsburgh Plate Glass Co., Brush Div., Dept. W-4, 3221 Frederick Ave., Baltimore, Md. Case histories indicate economies available to users of Pittsburgh brushes. Request on company letterhead.

Manufacturers' Literature

Ceramic Coatings. Solar Aircraft Co., 8 pp, illus. Uses and properties of Solaramic coatings, a family of proprietary ceramic coatings designed to protect high or low alloy steel fabrications from heat and/or corrosion. (233)

Corrosion Resistant Coating. Specialty Coatings, Inc., Div. of Thompson & Co., 6 pp, illus. Examples of how Vinsynite Pretreatment was used in finishing six different types of metal products for good paint adhesion and corrosion resistance. (234)

Wet and Dry Tumbling. Tumb-L-Matic, Inc., No. PC-52. Describes five processes for finishing metal and plastic parts by tumbling parts with abrasive materials in rotating barrels. (235)

Crack-Free Chromium. United Chromium Div., Metal & Thermit Corp., 4 pp, illus, No. CFC-1. Outlines properties of finishes obtainable with the new Unichrome, crack-free chromium plating process. (236)

Methods and Equipment

Corrosion Inhibitor. Solvay Process Div., Allied Chemical & Dye Corp., 17 pp, illus. Use of sodium nitrite in corrosion prevention. (237)

Heat Treating Equipment. American Gas Furnace Co., 140 Spring St., Elizabeth, N. J., 24 pp, illus., No. C-1304. Blow pipes, forges, pot furnaces, brazing and industrial heating machines. Request from American Gas on company letterhead.

Test Chambers. American Research Co., 4 pp, illus. Describes basic environmental test chambers for testing under a variety of conditions. (238)

Welding. American Welding & Mfg. Co., 23 pp, illus. Describes welding facilities. Also lists products and services. (239)

Resistance Welding. Ampco Metal, Inc., 4 pp, illus. Describes and illustrates facilities for producing resistance welding electrodes and alloys. (240)

Testing Machine. Baldwin-Lima-Hamilton Corp., 12 pp, illus., No. 4401. Hydraulic machines with capacities from 10,000 to 5,000,000 lb are described, including standard and special types of vertical and horizontal machines. (241)

X-Ray Equipment. Balteau Electric Corp., 6 pp, illus. Lightweight x-ray unit with high power and penetration range. (242)

Spectrograph. Bausch & Lomb Optical Co., 14 pp. Describes a 1.5 meter stigmatic spectrograph for laboratory use. (243)

Metallurgical Testing Equipment. Buehler Ltd., 12 pp, illus. Describes metallurgical specimen mount presses. (244)

Hardness Testers. Clark Instrument Inc., 4 pp, illus. Shows features of hardness testers and discusses their accuracy, speed of operation and durability. (245)

Nondestructive Testing Equipment. J. W. Dice Co., 1 p. Advantages and principle of operation of the model CE Cyclograph for nondestructive sorting of metal mix-ups. (246)

Sintering Furnaces. Drever Co., 12 pp, illus., No. B-101. Describes types of furnaces for sintering metal powder products. (247)

Metalworking Tools. Eaton Co., 34 pp, illus. Describes representative gear production machines and tools. (248)

Lightweight Flexible Ducting. Flexible Tubing Corp., 4 pp, illus. Various types of lightweight flexible ducting engineered for air handling, fume removal, dust collection, and materials handling. (249)

Reducing Atmosphere Generators. Gas Atmospheres, Inc., 4 pp, illus., No. R-352. Atmosphere generators for industrial applications such as bright hardening, annealing, gas carburizing and sintering. (250)

Rotary Hearth Furnaces. Gas Machinery Co., 4 pp, illus., No. A-102. Complete specifications of the Gasmaco rotary hearth furnaces for forging, annealing, heat treating or drawing operation. (251)

Temperature Controls. Claude S. Gordon Co., 4 pp, illus. Brief description and advantages of straight line, fully automatic temperature control. (252)

Inserts. Groov-Pin Corp. Self-tapping insert used as original equipment and for salvage and repair of stripped threads. (253)

Lock, Weld and Clinch Nuts. Grip Nut Co., 12 pp, illus. Specifications and applications for Gripco fasteners. (254)

Decimal Equivalent Chart. John Hassall, Inc. Easy-to-read decimal-equivalent wall chart of this company's cold headed parts. (255)

Electric Furnaces. Holcroft & Co., 4 pp, illus. General information on electric heating and various heat treat furnaces. (256)

Pyrometers. Illinois Testing Labs, Inc., 6 pp, illus. Thermoelectric pyrometer for precision measurements of temperatures beyond 1000 F. (257)

Tablet Presses. Kux Machine Co., 4 pp, illus. Tabletting presses for production of powdered metal parts, ceramic parts and explosives. (258)

Die Casting Machines. Lester-Phoenix, Inc. Folder lists features and specifications of die casting machines and injection molding machines. (259)

Vibration Control Materials. Lord Manufacturing Co., 12 pp, illus. Stock list of vibration-control shock mounts and couplings. (260)

Silver Brazing. Lucas Milhaupt Enginering Co., 16 pp. Information on silver brazing, its advantages and its uses. Charts illustrate types of joints and recommended preforms. (261)

Induction Heaters. Magnethermic Corp., 12 pp, illus. Describes low frequency brass and copper induction heaters for preheating metals. (262)

Aluminum Bronze Electrode. Metal & Thermit Corp., 20 pp, illus. Describes aluminum bronze coated electrode providing high strength, corrosion resistant deposit for arc welding manganese bronze castings and brass sheets or plates. (263)

Rivets. Milford Rivet & Machine Co. A handy slide rule selector gives complete rivet specifications. (264)

Spectrograph. National Spectrographic Sales Corp., 8 pp, illus. Spectrographic equipment and accessories. (265)

Welding Studs. Nelson Stud Welding Div. of Gregory Industries, Inc. Wall Chart No. 1. Dimensions and applications of standard MG studs. A 12-page descriptive booklet is also available. (266)

High Frequency Heating. New Rochelle Tool Corp., 16 pp, illus. Describes the principles of induction and dielectric heating. Includes typical specific applications of high frequency heating in welding, brazing and heat treating. (267)

Hole Quencher. Palmer Mfg. Co., 4 pp, illus. Features advantages of using the I. D. Hole-Quencher for case hardening holes seven times faster. (268)

Electric Furnaces. Pereny Equipment Co., 3 pp, illus., No. 4A. Advantages and illustrations of typical electric furnaces and kilns. (269)

Vacuum Unit. Radio Corp. of America, Scientific Instruments Section, 4 pp, illus, No. EM-61. Features applications, description and specifications of vacuum unit for vacuum deposition of metals and laboratory work. (270)

Screws. Russell, Burdsall & Ward Bolt & Nut Co., 8 pp, illus. Presents principle of fastening, advantages and specifications of Spin-Lock screws available in hex, pan, truss or flat heads. (271)

Ultrasonic Inspection. Sperry Products, Inc., 8 pp, illus, No. 50-105. Explains principle of ultrasonic inspection and illustrates latest types of equipment. (272)

Abrasive Materials. Sterling Grinding Wheel Co., 28 pp, No. 1-55. Catalog provides a quick means for selecting proper grinding wheels from factory stock and provides information for ordering custom-made abrasive tooling. (273)

Metal Powder Press. F. J. Stokes Machine Co., 4 pp, illus. Information on a 50-ton multiple-motion powder metal press. (274)

Fasteners. Townsend Co., 4 pp, illus. Describes permanent fastening with rivets designed for use on any model of tubular rivet setting machine. (275)

Weldbrazing. Uniworld Research Corp. of America, 4 pp, illus. Special steel filler alloys combine fusion welding and brazing process. This process is applicable to all types of gas and electric welding with standard welding equipment. (276)

Heat Treating Furnaces. Industrial Heating Dept., Westinghouse Electric Corp., 38 pp, illus, No. B-5459. Complete description of Westinghouse furnaces—large and small, gas and electric. (277)

Electric Radiant Panels. Edwin L. Wiegand Co., 4 pp, illus, No. L-1093. Detailed specifications of the new Chromalox electric far infrared radiant panels for heavy duty industrial heating, drying and curing operations. (278)

for young men who want to catch up to their bosses . . .

Alcoa's Up-to-Dater on Forgings

Four factual pages of news on the world's largest aluminum die forging, latest alloys, titanium, brass forging costs, hand forgings and other information for young men who want to catch up to their bosses.

Here's the world's largest

Forging history is being made as you read this. At Alcoa's Cleveland plant the world's largest closed die aluminum forging is being made. The part is a structural member for a jet bomber aircraft wing. It is 13 feet long, 3 feet wide, 12 inches thick. And it weighs 3,715 pounds. The die blocks weigh 60,000 pounds each. It is being forged on the giant 50,000-ton press operated by Alcoa for the United States Air Force.

Another example of what these giant presses save in machine time, man-hours and money is a jet bomber bulkhead. Alcoa was first asked to make it as an aluminum hand forging. We did, and it weighed 1,625 pounds. Redesigned, it was next made as a blocker-type forging on Alcoa's 15,000-ton press. It weighed 830 pounds. Now, here's the kicker. Redesigned again, the part was placed on the 50,000-ton press and squeezed out as a precision forging. This time it weighed 290 pounds! And imagine what happened to costs!

What does this illustrate? Simply that larger, more intricate forgings are a practical reality the way Alcoa makes them on the large hydraulic presses. Die life is lengthened. Draft angles drop from the customary 7° to 0°, in some cases. Machine time is cut dramatically. Thinner webs and ribs are possible. The actual forging, because it is squeezed instead of pounded, has smoother surfaces, less chance of surface defects, slivers and laps. And while you may never design a part that requires the facilities of our 15,000-, 35,000- or 50,000-ton presses, it's obvious that experience learned in solving problems like these can effect savings on your parts, regardless of the size and quantity. Let us prove it.

Need just a few? Need them in a hurry? Try hand forgings

Hand forgings come awfully close to what the blacksmith can beat out with an anvil and hammer. Except in Alcoa's shops, they grow to 2,500 pounds

Alcoa's Up-to-Dater on Forgings (continued)

and 300 inches long and 40 inches wide. Alert designers specify hand forgings when part requirements are few, or when designs are not final. In so doing, they avoid die costs and lost time.

This is old stuff to some, but we wonder if all designers realize that hand forgings can be had in far more intricate forms than the usual bars, slabs, biscuits, etc. And, further, they can be had in all the forging alloys.

The closer a hand forging approaches the shape of the finished part, the more metal and machining time is saved at your plant. Also, better mechanical properties come when the stock is forged to lighter sections. This extra quality is reflected in the strength of the finished part. But the dollars add up as a forging gets closer to the finished part. When does it pay? It depends on such things as machining costs, scrap wasted, work-load in your plant, properties necessary, etc. How to find out? Give your Alcoa sales engineer a sketch or drawing of the finished piece and an idea of the number needed. He will suggest the hand forging that might best serve your needs. Or, if you prefer, he will submit several propositions involving hand forgings ranging from the simplest shape to others coming closer and closer to your finished part.

We have just printed an informative, technical booklet, *Alcoa Hand Forgings*. Make sure you ask your Alcoa sales engineer for a copy. Or drop us a line.

Big news on small stuff

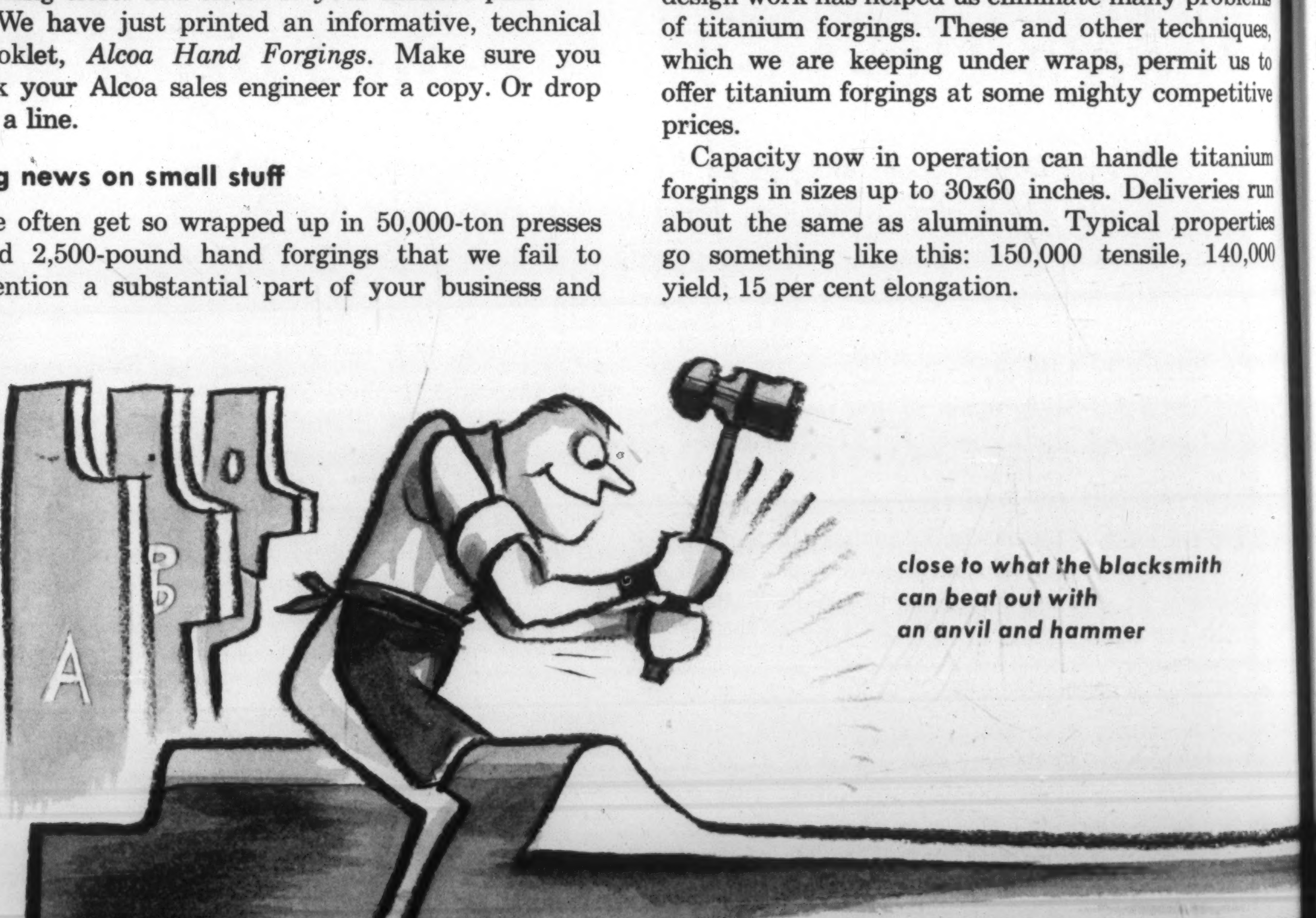
We often get so wrapped up in 50,000-ton presses and 2,500-pound hand forgings that we fail to mention a substantial part of your business and ours, i.e., small forgings. We operate a large percentage of our vast number of hammers and mechanical presses continuously on small forgings. These jobs are in our shops instead of somebody else's for one of several simple reasons: They cost less, and/or they're made better, and/or we deliver 'em faster, and/or we give more engineering service. It's the plain, unanodized truth that we can do the same for you. Let us quote.

The latest on titanium forgings

Titanium being the fourth most abundant structural metal in the earth's crust gives us more than a passing interest in the stuff. We don't make the basic metal sponge, or alloy it in ingots. But we are doing considerable development work in its fabrication that could easily accrue to your benefit. Titanium forgings are a case in point.

Being the country's largest light metal forging facility, we have equipment to do some remarkable things with titanium. Heavy-press capacity lets us forge it at optimum temperatures. This reduces the oxide film that forms at high temperatures and also results in better properties. Our pioneering work in no-draft forgings of aluminum plus superior die design work has helped us eliminate many problems of titanium forgings. These and other techniques, which we are keeping under wraps, permit us to offer titanium forgings at some mighty competitive prices.

Capacity now in operation can handle titanium forgings in sizes up to 30x60 inches. Deliveries run about the same as aluminum. Typical properties go something like this: 150,000 tensile, 140,000 yield, 15 per cent elongation.



close to what the blacksmith can beat out with an anvil and hammer

do some remarkable things with titanium

We see a lot in titanium beyond aircraft and ordnance. High-temperature processing equipment for corrosive materials is already a proven market for titanium forgings. Likewise severe marine applications. Now is the time to do some hard commercial planning with titanium. We'd like to help.

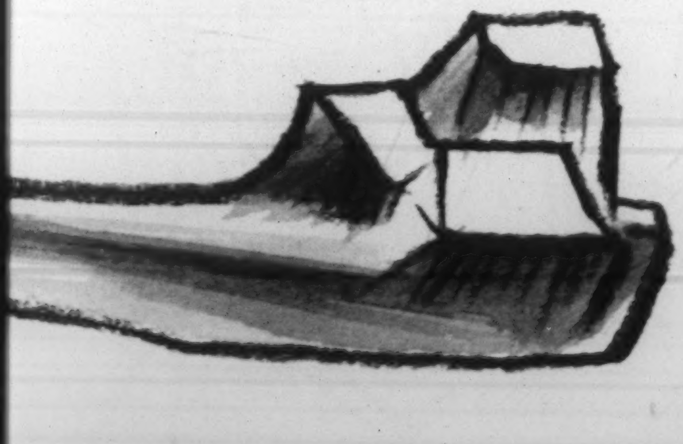
Buying brass forgings? Why?

"Why"—since aluminum costs one-sixth as much as brass?

"Why"—since aluminum has become so easy to forge?

We don't expect these simple facts to undermine the foundations of the brass forging industry. But they are particularly pertinent in these competitive days. We don't mean to imply that every part now forged in brass would be less costly in aluminum. But the plain truth is that if more users of brass forgings would ask themselves "Why," there'd be a whopping lot of money saved.

A tour through Alcoa's forge plants will show aluminum forgings such as valve and pipe fittings, luggage hardware and many other parts that used to be brass. They are now aluminum for one main reason only. Cost. Yet it is equally true that these users have gained more than money. Their products are lighter—about half as heavy for equal strength. They are rustproof. They can be colored any shade of the spectrum right in the metal surface. They conduct heat and electricity like—well, like brass.



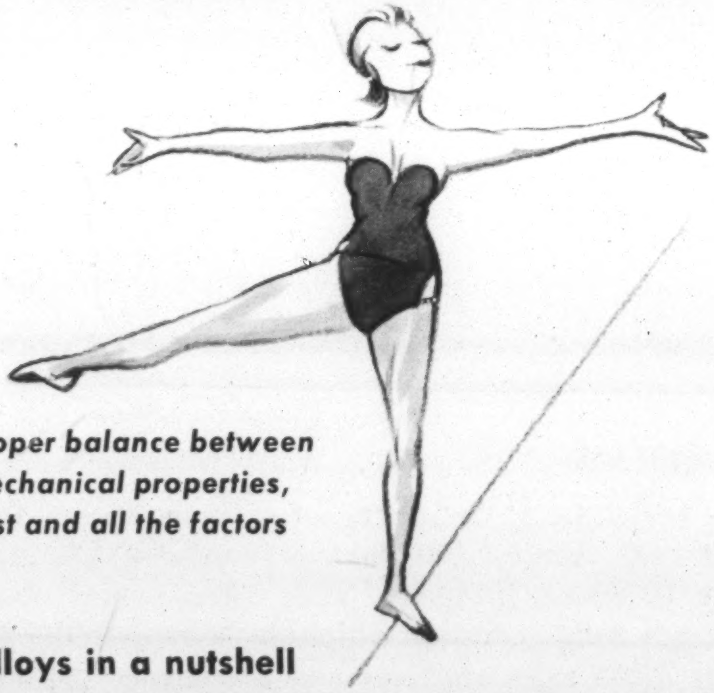
If you have an inkling that your brass part might cost less in aluminum, let us inkle with you. The difference could be considerable, and the consultation is painless and free.

About quality control

This is something that everyone talks about, and few have to a degree that makes it really worth while. Usually the palaver goes something like this: "Every step is closely guarded by standards of rigid quality control, using utmost skill and the latest methods of inspection."

Next time you hear something like that, get the specifics and check them against Alcoa's tally: Ultrasonic inspection, fluorescent penetrant inspection, destructive testing, sectional testing for grain flow, Brinell tests, plus hundreds of visual checks and inspections throughout the process.

There's a difference.



proper balance between mechanical properties, cost and all the factors

Alloys in a nutshell

Maybe the toughest nut in designing for aluminum forgings is picking the right alloy. On the next page is a skeleton table along with brief comments about each alloy. Note alloys X-7079 and X-2219, just announced a few months ago. Alloy X-7079 is a new high-strength deal like 7075. But it provides a higher level of short transverse elongation plus being less apt to distort on machining. Alloy X-2219 offers a lot of new features for problems in 500-600°F range. There's lots more to the alloy story and we think your Alcoa salesman is the right man to help you get the proper balance between mechanical properties, costs, and all the factors that go into the picking of the alloy that's exactly right for your job.

Alcoa's Up-to-Dater on Forgings (continued)

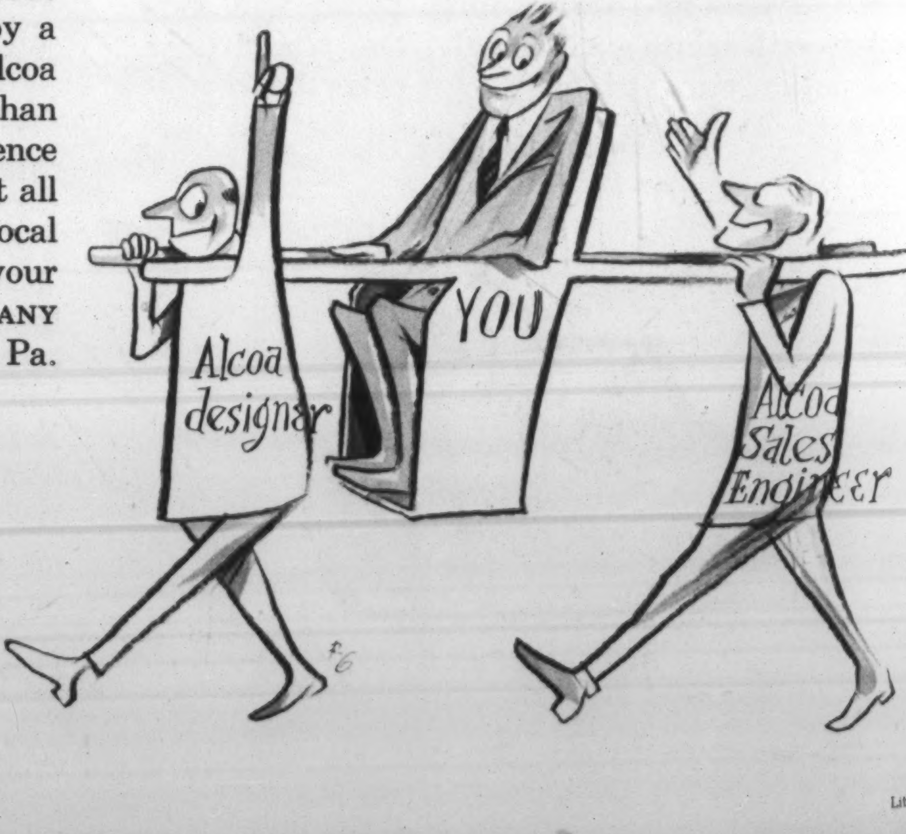
MECHANICAL PROPERTIES OF ALCOA® ALUMINUM FORGINGS

	MINIMUM SPECIFICATION VALUE (1)			TYPICAL VALUES (1)			
ALLOY	TENSILE STRENGTH	YIELD STRENGTH	ELONGATION % in 2"	TENSILE STRENGTH	YIELD STRENGTH	ELONGATION % in 2"	BRIEF ADVANTAGES OF ALLOY
2014-T6	65,000	55,000	10	70,000	60,000	13	readily forgeable, high strength.
X-2219	55,000	35,000	6	62,000	43,000	16	high strength in 500-600°F temperature range.
6151-T6	44,000	37,000	14	48,000	43,000	17	good mechanical properties, readily forgeable.
7075-T6	75,000	65,000	10	82,000	72,000	11	highest strength.
X-7079	74,000	64,000	10	78,000	68,000	14	high strength, improved ductility in transverse, less quench sensitive.
4032-T6	52,000	42,000	5	55,000	46,000	9	high strength at elevated temperature. Selection between these three alloys depends on individual requirements.
2218-T72	38,000	29,000	8	46,000	36,000	10	
2018-T61	55,000	40,000	10	62,000	48,000	12	
6061-T6	38,000	35,000	10	45,000	40,000	17	superior welding and brazing qualities, readily forgeable, corrosion resistant.
2025-T6	55,000	33,000	16	58,000	37,000	19	special-purpose propellers, etc.

(1) For forged sections to 4" thick for all alloys except 7075-T6 which is 3" and X-7079 which is 6".

Straight talk

In these days of designing for sales as well as performance, many a designer has found a competitive edge in Alcoa Forgings. This often comes about through solid technical thinking contributed by a local Alcoa sales engineer and a designer in Alcoa forge shops. It is this help, perhaps more than machines and equipment, that makes the difference in dealing with Alcoa. And the practicality of it all is that it's free. Your first step is to call the local Alcoa sales office listed under "Aluminum" in your classified phone book. Or write, ALUMINUM COMPANY OF AMERICA, 1994-F Alcoa Bldg., Pittsburgh 19, Pa.



Your Guide to the Best in Aluminum Value

ALCOA ALUMINUM FORGINGS
ALUMINUM COMPANY OF AMERICA

New Taylor Copper-Clad Laminates

now available in production quantities

Why Taylor Copper-Clad Laminates Help Capitalize the Full Potential of Printed Circuits . . .

Taylor's ability to use high purity rolled copper—in weights of one, two or three ounces per square foot—assures production of materials that will more satisfactorily meet industry's needs because...

Rolled copper surface is smoother (freer from pits, pinholes and imperfections) . . . more uniform thickness . . . no sacrifice in conductivity. *Result:* Consistently satisfactory etching at better production rates.

After months of research and experimentation, Taylor is now in production on two brand new copper-clad laminates that give you opportunity to realize—on a sound basis—the full potentials of printed circuit construction.

Produced by an exclusive Taylor process that permits the use of readily available, high purity rolled copper, these laminates are supplied in two grades—XXXP-242 Copper-Clad, with a premium quality phenol paper base material; and GEC Copper-Clad, with a superior epoxy glass base material.

Taylor makes both of these copper-clad laminates in sheets approximately 37 x 49 inches . . . in thicknesses from .015 to .25 inches . . . with copper on one or both sides.

Whatever your experience with copper-clad laminates . . . whatever your ideas on the subject . . . it will be to your advantage to find out just what the new Taylor materials can do for you. Contact the nearest Taylor sales engineer . . . for more information or for your sample order.

Taylor GEC Copper-Clad provides . . .

- Superior electrical and mechanical qualities for critical applications.
- High electrical stability over wide humidity range.
- High resistance to dip soldering temperatures up to 500 F.
- High insulation resistance and surface resistivity after etching.
- Ready punchability.
- Good, uniform copper-to-laminate bond strength.

Taylor XXXP-242 Copper-Clad provides . . .

- Cold punchability. For intricate punchings—warm to 150 F. max.
- High resistance to dip soldering temperatures up to 500 F.
- High insulation resistance and surface resistivity after etching.
- Translucence. Permits easy checking of circuit alignment on opposite side.
- Good, uniform copper-to-laminate bond strength.

TAYLOR FIBRE CO. Plants in Norristown, Pa. and La Verne, California

Branch Offices

Atlanta
Boston*
Chicago*
Cleveland*
Dayton*
Detroit*
Indianapolis
Los Angeles
Milwaukee*
New York*
Philadelphia
Rochester*
San Francisco*
St. Louis
Rockville, Conn.

**Teletypewriter service at both plants and these branches.*

Distributors

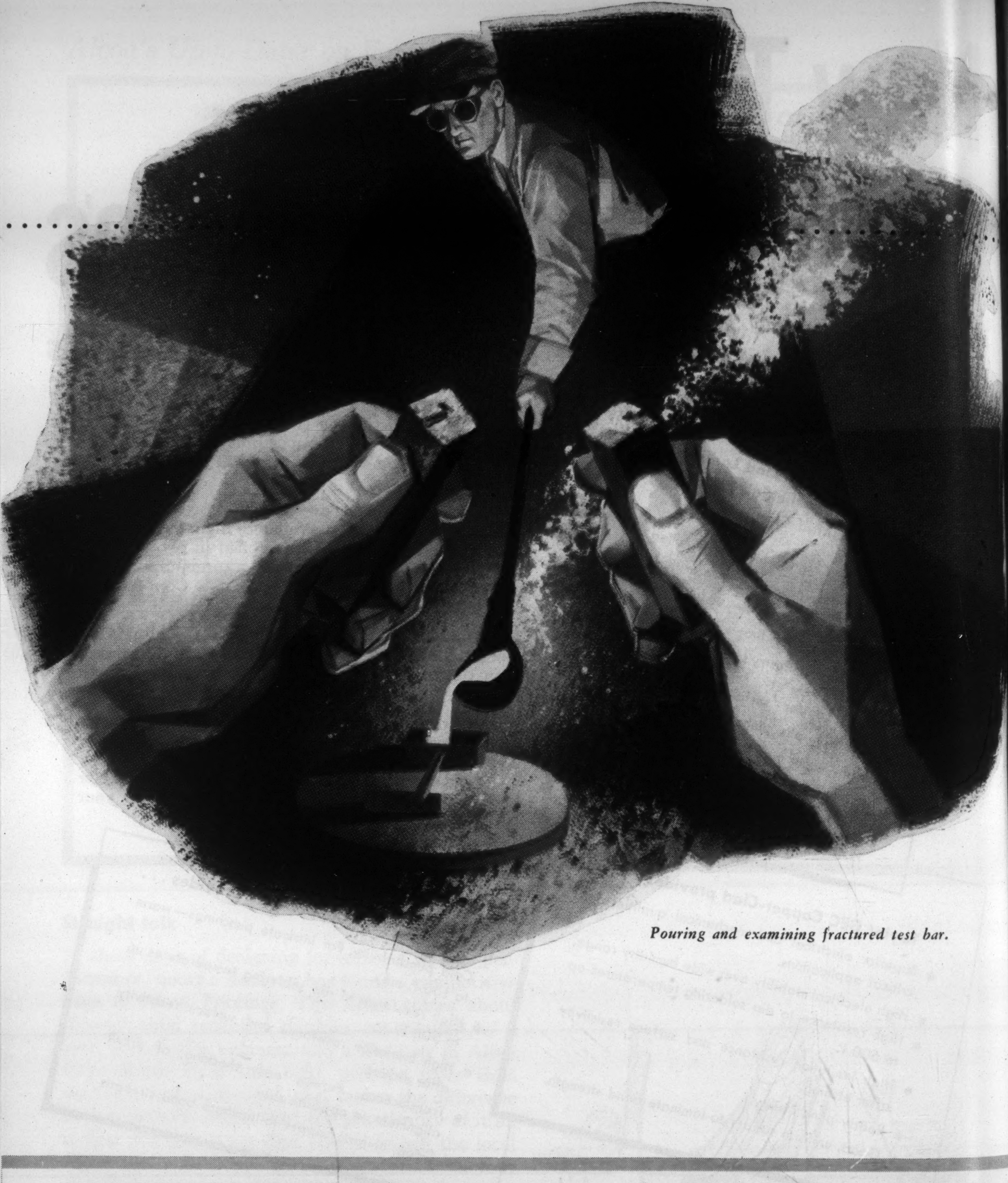
Grand Prairie, Texas
Houston
Miami
Toronto

TAYLOR

Laminated Plastics
Vulcanized Fibre

◄ For more information, Circle No. 551

For more information, turn to Reader Service Card, Circle No. 398



Pouring and examining fractured test bar.

Here are quick facts about some of the widely used Sivyer Steels. Which meets your needs best?

SIVYER CARBON STEEL	SIVYER HI-CARBON STEEL	SIVYER MANGANESE-MOLYBDENUM STEEL	SIVYER CHROME-MOLY STEEL
Plain carbon steel (.20-.30 C) gives you these average properties: Yield point 40,000 psi; Tensile strength 73,000 psi; Elongation 2″ 24%; Reduction of Area 45%. For general applications.	Carbon content of .40-.50. Has higher strength than low carbon steel. Often used in the liquid-quenched and drawn condition.	A low alloy steel having an excellent combination of strength and ductility. Average values, normalized and drawn: Yield point, 58,000 psi; Tensile strength 90,000 psi; Elongation 24%; Reduction of area 45%. Liquid quenching and suitable drawing will increase either hardness and strength, or toughness as desired.	Conforms to SAE 4140 analysis. Especially suited to applications where relatively high hardness and ductility is required. Hardens to a greater depth than most steels and is useful where hardness is required in heavier sections.

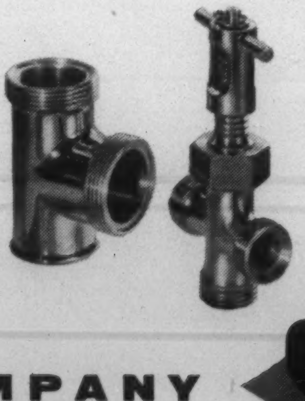
. . . **Specify SIVYER**

— and get the longest life and best performance you can buy in steel castings

When your carbon and low-alloy castings bear the famous Sivyer ◈, you're set for long service and dependability. From initial planning to final inspection every Sivyer casting job is undertaken with one thought foremost — to make our "finished product" a raw material your shop can use with confidence.

Good finish, high dimensional accuracy, compositional uniformity, clean-cored holes, accurate heat treatment, thorough inspection — these are only a few of the advantages you get when you specify Sivyer steel castings. That's why it's easier and why it costs less to use Sivyer castings. They save time and money for your shop. They reduce the amount of metal to be removed. They speed machining, and assure the rapid assembly which accurately dimensioned parts permit.

Sivyer engineers are glad to work with you on any casting problem. Send your prints for prompt quotation.



SIVYER STEEL CASTING COMPANY

Main Office: 1675 SOUTH 43rd STREET • MILWAUKEE 14, WISCONSIN

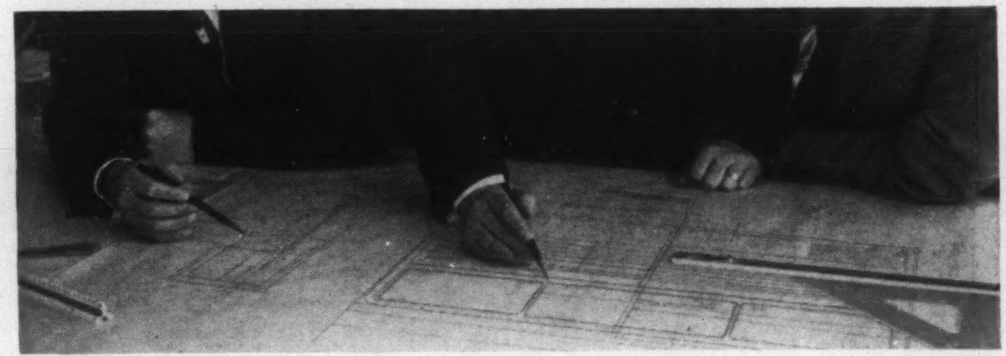
SIVYER

For more information, turn to Reader Service Card, Circle No. 410

Craftsmanship of the 20th Century

Today's industrial designers face a dual challenge in the race to outdistance competition. Their products must be more pleasing in appearance, more efficient in performance. Many of these designers are working closely with plastics engineers in the custom molding industry to achieve both goals simultaneously. Read how one of America's leading manufacturers of air conditioning units improved sales in a fiercely contested market by utilizing the unique properties offered by plastic materials.

New housings of Lustrex Styrene plastic are building business for Fresh'nd-Aire



DESIGN OBJECTIVES. In creating a new line of air conditioning units, the management of the Fresh'nd-Aire Company, division of the Cory Corporation, Chicago, required an interior housing with many advanced features. The new housing had to have sleek decorating styling to make it an outstandingly handsome piece of furniture. It had to incorporate tight-fitting removable parts. It also had to be produced at reasonable cost.

MATERIAL SPECIFICATION. Careful testing by Fresh'nd-Aire engineers proved that Lustrex high impact styrene offered the most desirable characteristics. A styrene housing could be economically produced with an attractive, soft-lustered, surface-to-surface coloring in the specified shade. This eliminated six costly painting and cementing operations. Injection molding techniques for high impact styrene freed designers from the restrictions of metal die-stamping machines. Modern smooth-flowing lines could be obtained. There was no danger of rust or corrosion deteriorating the housing. Furthermore, Lustrex high impact styrene provided a strong base for rivets, bolts and other anchoring devices. This tough Monsanto styrene also demonstrated its ability to hold critical dimensions. Parts like reversible vents and a front cover accessory panel could be removed and replaced repeatedly without the hazard of bending out of snug fit.

PRODUCTION ENGINEERING. General American Transportation Corporation, Chicago, was commissioned to supply the styrene housing for Fresh'nd-Aire. Every design requirement was satisfactorily met by molding the component of Monsanto Lustrex Hi-Test 88, a rubber-modified high-impact styrene. The part is produced in a hydraulic 1500-ton press and contains 40 ounces of the Monsanto styrene material.

THE FINISHED PRODUCT. The new Fresh'nd-Aire unit has earned the hearty approval of both trade and public. Sales officials agree the change to styrene components has improved the marketability of the line. The interior housing and exclusive "Style-Gard" accessory panel have added vital style interest to the unit—and improved its performance. A 300% sales increase over last year is anticipated for the 1956 season.

This is one of hundreds of design and production problems which have been solved by utilizing the facilities of the plastics custom molding industry. These 20th Century craftsmen are available to manufacturers designing for greater efficiency and lower costs. As a major supplier of plastic resins, Monsanto is in a position to introduce you to custom molders who will put their skills to work for you. If you are considering a design change for your product line, be sure to investigate plastics. Write to Monsanto Chemical Company, Industrial Applications Dept., Room 1281, Springfield 2, Mass.

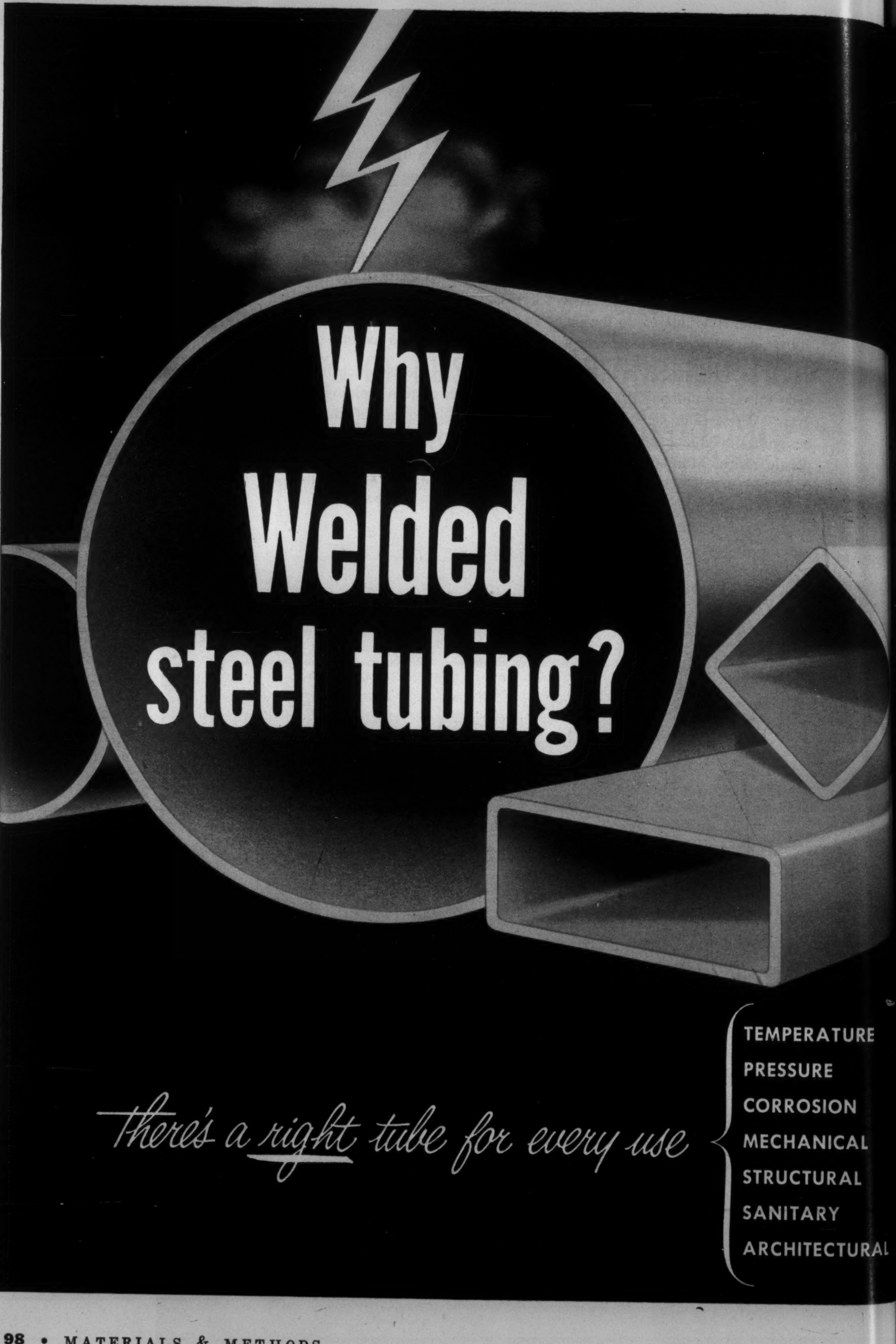
For more information, Circle No. 544

Investigate the Monsanto completely-balanced line of styrene plastic compounds developed for particular applications and sold under the trade name . . .

LUSTREX®

Styrene Plastic

MONSANTO®



Why Welded steel tubing?

there's a right tube for every use

- TEMPERATURE
- PRESSURE
- CORROSION
- MECHANICAL
- STRUCTURAL
- SANITARY
- ARCHITECTURAL

Saves Time and Operations
Easy to Fabricate Efficiently
Uniform in Dimensions and Properties

An industry united to produce quality tubing

25 years ago the quality producers of welded steel tubing *united* to create the Formed Steel Tube Institute. This association of producers is dedicated to the development and pooling of tubular product research, improved production methods and rigid quality control. The success that welded steel tubing enjoys as one of the most reliable and widely used tubular products in the world is the direct result of this industry's progressive cooperation.

FORMED STEEL TUBE INSTITUTE
AN ASSOCIATION OF QUALITY TUBE PRODUCERS

FORMED STEEL TUBE INSTITUTE **(MM)**
850 Hanna Building, Cleveland, Ohio

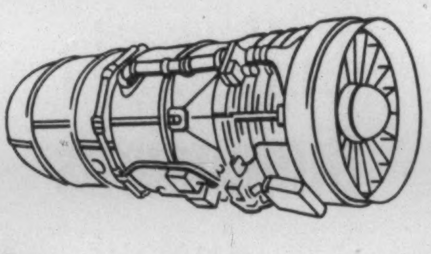
Send us your idea-packed sound movie showing how to design with and use welded steel tubing for showing:

____
(please show alternate dates)

Name______________________________
Company______________________________
Address______________________________
City______________ Zone______ State______________
We manufacture______________________________

For more information, turn to Reader Service Card, Circle No. 574

You get extra WEAR RESISTANCE



with Flame-Plating by Linde

Trade-Mark

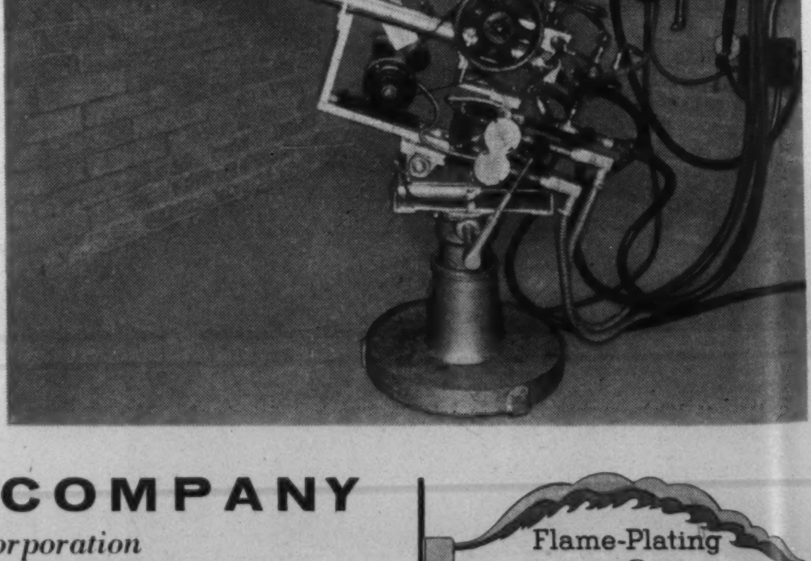
Flame-Plating — a remarkable detonation process — is now being used to coat metal parts with a thin coating of tungsten carbide or aluminum oxide. Results from experience with parts in actual use show that Flame-Plating solves many problems of wear, abrasion, and fretting corrosion.

The temperature of the part being coated seldom exceeds 400-deg. F. Precision parts can therefore be Flame-Plated without risk of changes in their metallurgical properties or physical dimensions. Practically all metals can be Flame-Plated—steel, copper, aluminum, magnesium, molybdenum, titanium. Coatings of tungsten carbide and aluminum oxide can be Flame-Plated in thicknesses from .002 to .010 inch, and finished to 0.5 microinches rms.

Flame-Plating applications have been proved in service. Parts for aircraft and rocket power plants, hydraulic systems, and heating units, as well as various types of plug and ring gages, bearings and seals, and dies have had their useful lives considerably extended—economically—by Flame-Plating.

Find out how Flame-Plating can help to improve your own product. Request a copy of the free booklet, "Flame-Plating," F8065. Address "Flame-Plating, Department N-6."

FLP
Service Mark



The Flame-Plating gun consists mainly of a barrel and a mechanism for loading precise amounts of powder and gases into a firing chamber. The powder remains suspended in the explosive gases until a spark ignites the mixture, producing heat and pressure waves of tremendous force. The molten particles are hurled with supersonic velocity against the workpiece where they fuse and build up until the desired thickness is obtained.

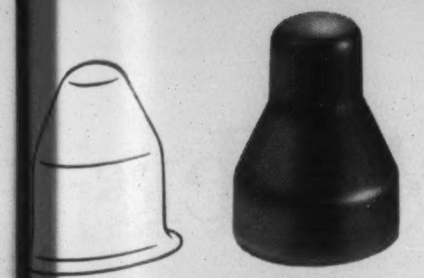
The term "Linde" is a trade-mark, and FLP is a service-mark of Union Carbide and Carbon Corporation.

LINDE AIR PRODUCTS COMPANY
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street UCC New York 17, New York
In Canada: Linde Air Products Company, Division of Union Carbide Canada Limited, Toronto

Flame-Plating by Linde

For more information, turn to Reader Service Card, Circle No. 482

For more information, Circle No. 507



PREFORM
1 11/16″ dia.
1 5/16″ high

FINAL FORM
1 11/16″ dia.
2¼″ high

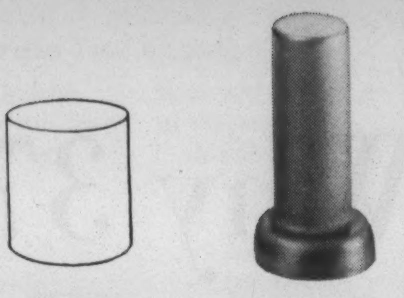
2 OPERATIONS plus anneal—.032″ AMS 5521. Jet engine part formed by redrawing a cup.

PREFORM
3¾″ dia.
3¼″ high

FINAL FORM
2⅞″ dia.
5⅛″ high

PREVIOUS METHOD

2 OPERATIONS—.043″ AMS 5540. Jet engine part formed by redrawing a cup. Part at right shows previous forming method of welding two stamped sections together.



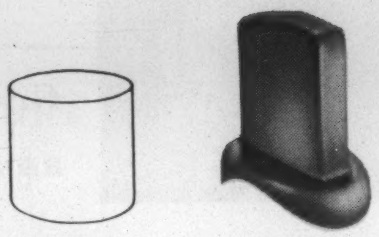
PREFORM
1½″ dia.
1¾″ high

FINAL FORM
15/16″ dia.
2⅜″ high

2 OPERATIONS—.020″ Hy Mu 80. Part formed by redrawing a cup.

Hydroforming

takes less time, less dollars to form tough shapes, tough metals



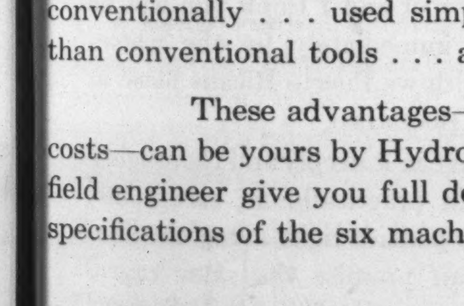
PREFORM
1⅝″ dia.
1¼″ high

FINAL FORM
1⅜″ long
½″ wide
1½″ deep

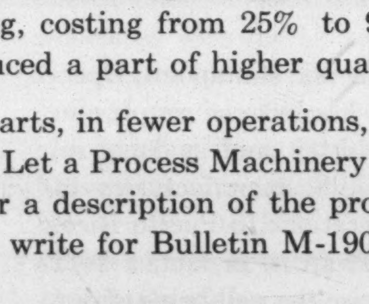
2 OPERATIONS plus anneal—.025″ Brass. Instrument cover formed by drawing a cup into the final rectangular shape.

■ Shown here are several parts drawn on Cincinnati Hydroform machines. These range from tough shapes of ductile materials to less complex shapes of harder-to-work alloys. In each instance, Hydroforming substantially reduced the number of operations required to form the part conventionally . . . used simple tooling, costing from 25% to 90% less than conventional tools . . . and produced a part of higher quality.

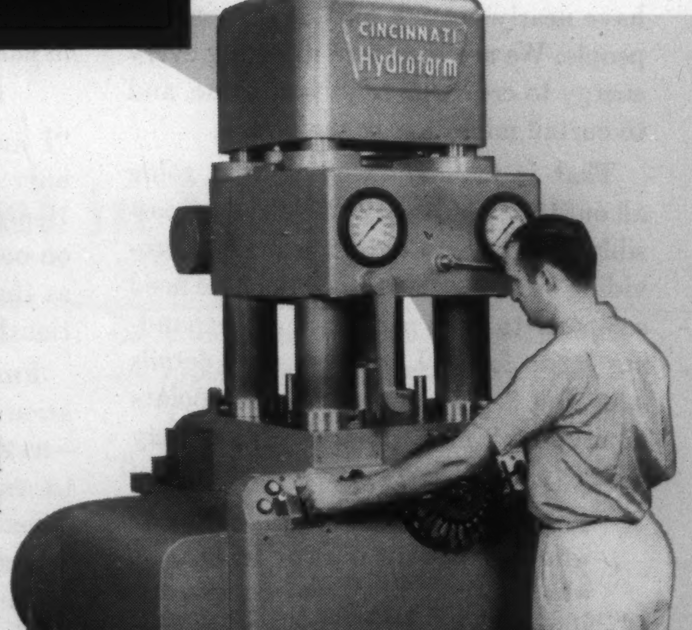
These advantages—better parts, in fewer operations, at lower costs—can be yours by Hydroforming. Let a Process Machinery Division field engineer give you full details. For a description of the process and specifications of the six machine sizes, write for Bulletin M-1908.



1 OPERATION—.030″ Brass. Automotive detail.



1 OPERATION—.034″ CRS, deep-drawing quality. Previous forming method required drawing the can, cutting a slot in the wall and welding on the protruding section.



CINCINNATI 8″ HYDROFORM
Also built in 12″, 19″, 23″, 26″ and 32″ sizes.

Hydroform

PROCESS MACHINERY DIVISION
THE CINCINNATI MILLING MACHINE CO.
CINCINNATI 9, OHIO, U. S. A.

Why 371 U. S. manufacturers now enjoy 100% tax

Governor Muñoz tells why Puerto Rico offers such amazing incentives to new or expanding manufacturers.

"In this statement, I shall try to explain Puerto Rico's economic position as frankly as I would to any manufacturer or labor leader who met me face to face.

Puerto Rico is currently making a determined effort to stand squarely on its own economic feet. At present we do not have nearly enough jobs to support our people. We are therefore directing every energy to create more jobs at home, and to curtail migration to the States.

That is precisely why we are going all out to attract every *new* plant we possibly can. But, to date, we are still providing only 25% of the new jobs we need *each year* to keep pace with our expanding labor force. I shall go into details later. But first I want to make two points of my Government's policy absolutely clear:

1. Puerto Rico has no intention of winning industries *away* from anywhere. We do not grant tax concessions to *runaway* plants.

2. Puerto Rico's Industrial Development Plan is based on a combination of absolutely ethical incentives. We do *not* and *never will* hold out low wages as an attraction to business. My Government's firm philosophy is that wages should rise as rapidly as our economic development permits.

Let me now describe our basic problem in more detail."

Our Problem

"When people talk of over-population as Puerto Rico's biggest headache, they certainly don't exaggerate. Our unemployment is high. Our income level is still low—only 25% of the U. S. average. And every year 20,000 more workers swell our under-employed labor forces.

But this is probably putting the cart before the horse. Our real problem is not over-population but *under*-development. What then is our best solution?"

Our Solution

"I am convinced that the answer can only lie in more and more industry. Hence we are pinning our major hopes on our industrial development program, as the main pull of what we call Operation Bootstrap.

From the economic standpoint, Operation Bootstrap has but one simple aim—to develop industry, and in doing so, to encourage U. S. manufacturers to *expand* their operations to Puerto Rico. Operation Bootstrap is, in fact, a bold attempt to increase the well-being of our whole Commonwealth—workers and employers alike. And lest anyone should fear that my country's program might injure the U. S. economy, let me now sound a reassuring note:

1. The U. S. already has 65 *million* employed. Puerto Rico only needs to create 150 *thousand* new jobs to solve its present problem.

2. One half of one percent of normal U. S. industrial *expansion* would achieve our whole economic program.

I hope these comparisons help to put Puerto Rico's modest needs in proper perspective. But, for good measure, let me quote a few more figures to show how important a prosperous Puerto Rico is to U. S. business itself:

In 1955, Puerto Rico's purchases from the U. S. rose to $580,000,000. *Without* Puerto Rico as a customer, New York's gross sales would have dropped by $67,000,000; California's by $54,000,000; New England's by $53,000,000.

So much for statistics. Now just a word about my people, without whose willing co-operation Operation Bootstrap would merely be a sterile dream."

Bootstrap Underway

"Pay us a visit and I think you will be impressed immediately by the wholehearted faith we Puerto Ricans place in Operation Bootstrap.

We believe in it deeply and thoroughly—and, with practically no exceptions, support its policies right along the line. Thus, I can promise the same eager, cheerful co-operation to every U. S. manufacturer who expands his industry to our Commonwealth.

Scarcely a month goes by that I am not visited by the Mayors of a dozen Puerto Rican towns, all asking for plants to be erected in *their* areas. There's not a community in all Puerto Rico that would not enthusiastically welcome the arrival of a new factory.

For we all realize that though we have made a promising start up the long, long hill to economic prosperity—the summit is not in sight yet. But the Puerto Rican people have squared up to their challenge and are meeting it in good heart."

in Puerto Rico freedom

Corporate Tax Exemption

If your net profit after U. S. Corporate Income Tax is :	Your net profit in Puerto Rico would be :
$ 29,500	$ 50,000
53,500	100,000
245,500	500,000
485,500	1,000,000

Dividend Tax Exemption*

If your income after U. S. Individual Income Tax is :	Your net income in Puerto Rico would be :
$ 7,760	$ 10,000
15,850	25,000
25,180	50,000
51,180	200,000

*Dividends are tax-free only if paid to residents of Puerto Rico by a tax-exempt corporation. Examples are based on Federal rates (Jan. 1, 1956) for single persons.

Beardsley Ruml tells how new or expanding industries (not runaway plants) get tax exemption.

"START A NEW plant in Puerto Rico and you are not only free from Federal income taxes (they don't apply) – you can be exempt from *local* income taxes too. Your freedom from Federal taxes is *not* a concession. It is a *Constitutional* fact which stems logically from that historic American principle 'Taxation without representation is tyranny.' Puerto Rico has no vote in Congress, and therefore no Federal income taxes – corporate or personal."

Protected by Two Constitutions

"Your business is not only protected by the Commonwealth Constitution, it is permanently guarded by all the guarantees of the U. S. Courts and Constitution, too.

As for your *local* income tax exemption, this is an *added* incentive, offered by the Commonwealth Government to attract new plants that Puerto Rico's economy needs so urgently."

How you gain from a new plant in Puerto Rico

1. A better return. Local tax concessions, freedom from Federal taxes, and lower operating costs will all reflect favorably in your company's balance sheet. See table above.

2. Abundant, skillful labor. Puerto Rico's labor force totals 644,000. The Commonwealth operates an ambitious vocational training program, which will even screen workers and teach them *specially* to operate your machines. The adeptness of the Puerto Rican worker in learning precision skills may be judged by the fact that the following famous companies now have operations in Puerto Rico:

Remington Rand. St. Regis Paper. Beaunit Mills. International Latex. Carborundum Company. Shoe Corporation of America. United Drill and Tool. Sunbeam Electric. Univis Lens. Weston Electrical Instrument Company.

3. No currency or customs problems. Puerto Rico is a Commonwealth freely associated with the United States. It is an integral part of the U. S. economic system. You have none of the problems of operating from a foreign country. Movement of goods, money and people between Puerto Rico and the U. S. is as free as it is between the states of the Union. There's no duty on trade and the U. S. dollar is currency.

4. Low capital investment. New single-story, low-rental factories are ready to occupy. The government will even build a *special* one for you on a very small down payment. Abundant electricity, gas and water are just waiting to be connected.

5. Ideal location. Puerto Rico is served by 30 ocean lines and 8 airlines. It is only 5½ hours by air from New York – less than 4 from Miami. Goods are actually made in Puerto Rico one day and are delivered in Los Angeles the next. The climate is perpetual Spring. Temperature stays around the balmy 70's most of the year. Swimming, sailing and fishing are superb. Domestic help is plentiful.

Is Your Company Eligible?

To find out if your company is eligible for tax exemption in Puerto Rico, call our nearest office:

New York	**MU 8-2960**	579 5th Ave.
Chicago	**AN 3-4887**	79 W. Monroe
Los Angeles	**WE 1-1225**	5525 Wilshire

New booklet—free to manufacturers

Commonwealth of Puerto Rico
Economic Development
Administration
579 Fifth Ave., New York 17, N.Y.
Dept. MM-61

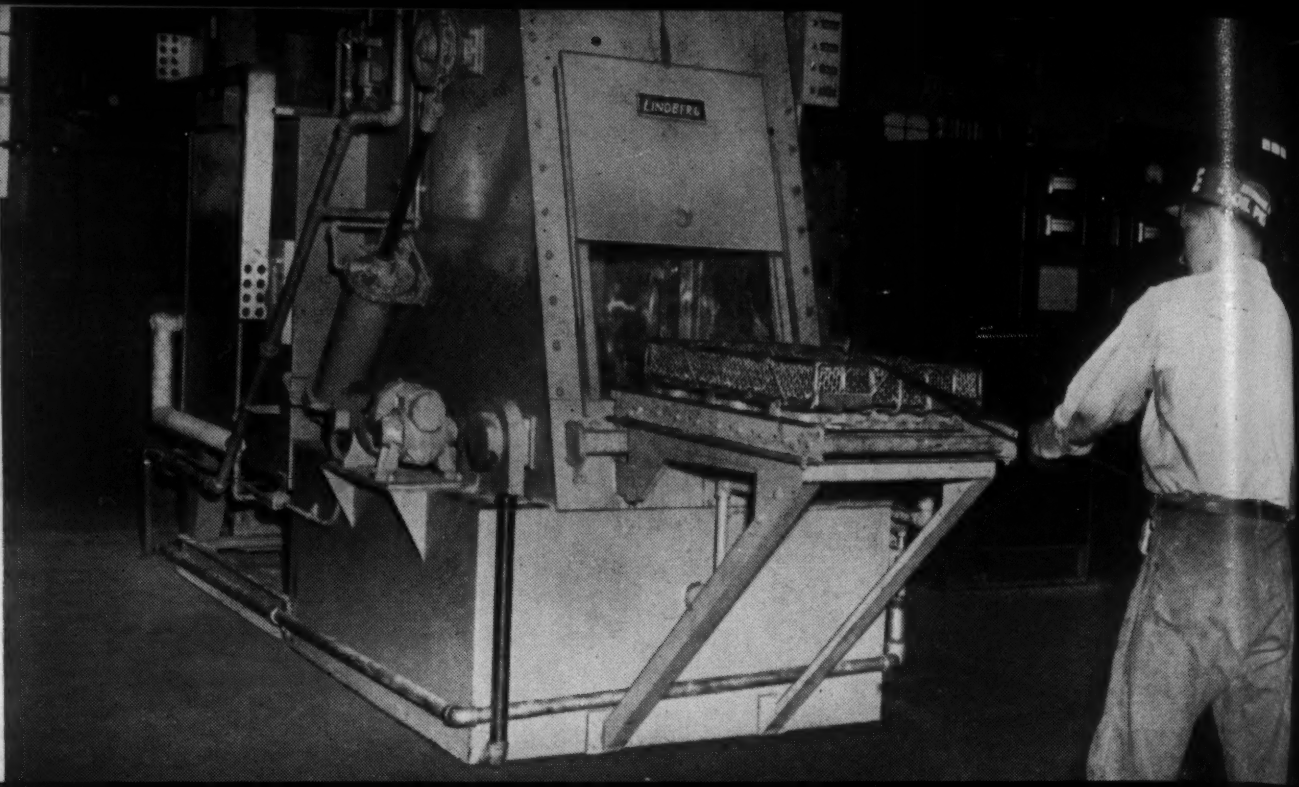
Mail me "Facts for the Manufacturer," your report of the advantages of Puerto Rico for plant location.

Name ____________
Company ____________
Product ____________
Address ____________
____

• **For more information, turn to Reader Service Card, Circle No. 383**

ALLIED

New Lindberg electric furnace with CORRTHERM element at Allied Metal Treating Corporation, Kenosha, Wisconsin. This furnace is used 24 hours a day, 6 days a week, for carbonitriding, clean hardening pinion gears, hardening crank shafts after carburizing and carburizing small gears and shafts.

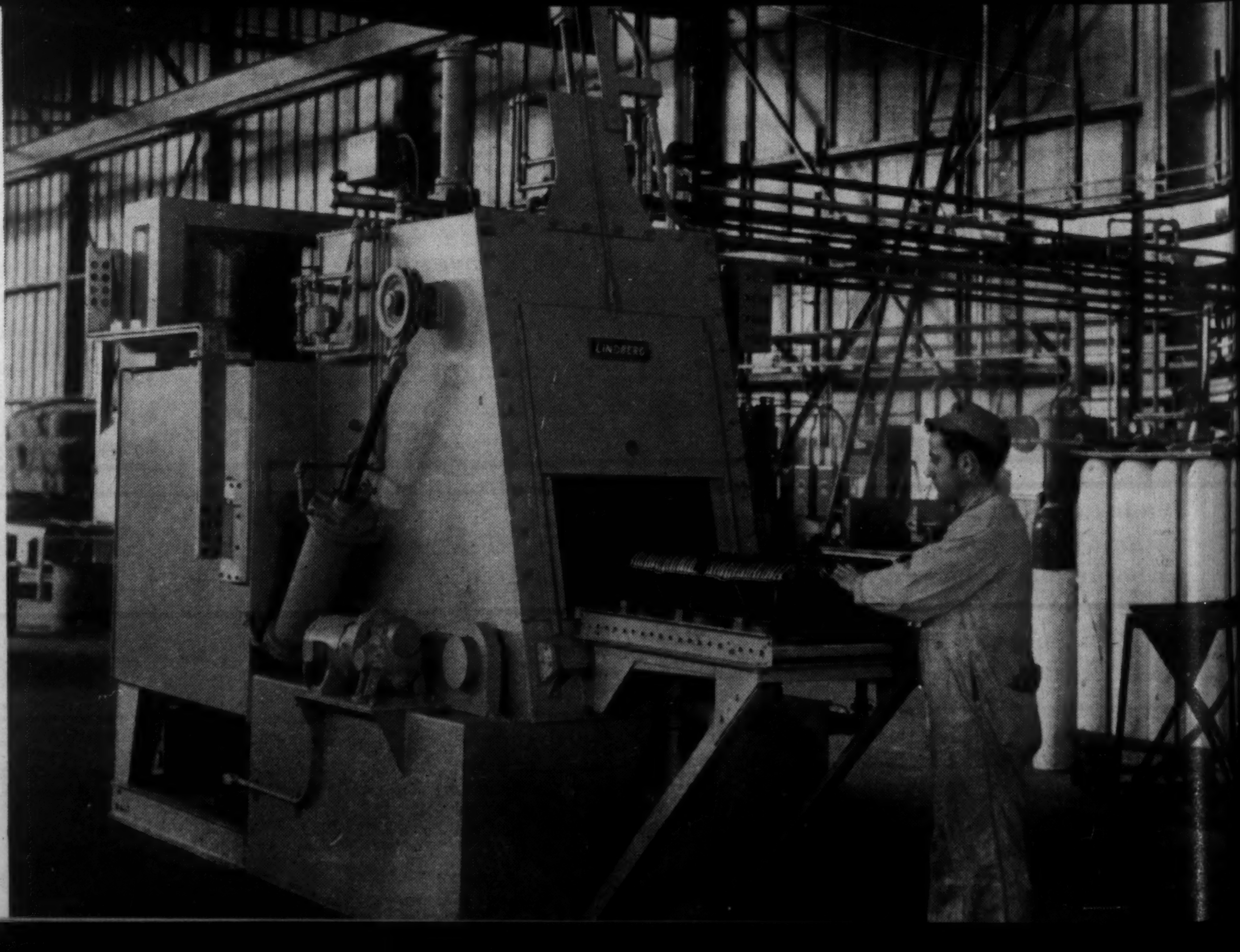


EKLUND

Installation of new Lindberg furnace with CORRTHERM electric element at Eklund Metal Treating, Inc., Rockford, Illinois. Furnace used 24 hours a day, 7 days a week, for carburizing gears and machine tool parts, carbonitriding sheet metal screws and automotive parts, and hardening and tempering bolts.

PERFECTION

Lindberg electric furnace with CORRTHERM element just installed at Perfection Tool & Metal Heat Treating Company's Lombard, Illinois plant. This furnace is being used 24 hours a day, 6 days a week, for carbonitriding and carburizing parts for automotive and farm implement industries.



COMMERCIAL HEAT-TREATERS QUICK TO ADOPT LINDBERG ELECTRIC CARBONITRIDING FURNACES WITH NEW CORRTHERM HEATING ELEMENT

s significant that commercial heat-treaters, always in the lead in the eptance and development of better heat-treating methods, have been ong the first to appreciate the revolutionary advantages of Lindberg's vly announced CORRTHERM electric heating element.

Recent Lindberg CORRTHERM-equipped furnace installations in nts of three leading midwestern commercial heat-treaters are shown the opposite page.

Where electricity is the preferred source of heat Lindberg furnaces h CORRTHERM provide to the fullest degree the versatility and pendability required in efficient commercial heat-treating. Ideal for rbonitriding, they are readily applicable to other processes—carburiz-, carbon restoration, bright hardening or annealing, and normalizing.

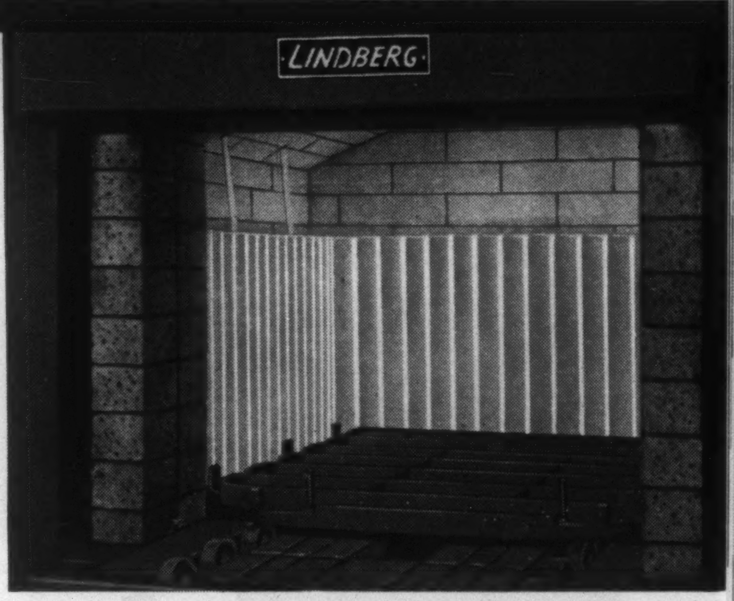
Whether your heat-treating operations are commercial or captive, ge or small, the CORRTHERM element in Lindberg electric furnaces ers you these exclusive advantages:

Low voltage—operates at extremely low voltage. No leakage through carbon saturation.

Atmosphere Circulation—elements act as baffle to direct circulation of convection streams.

Safety—extremely low voltage eliminates shock or short hazards.

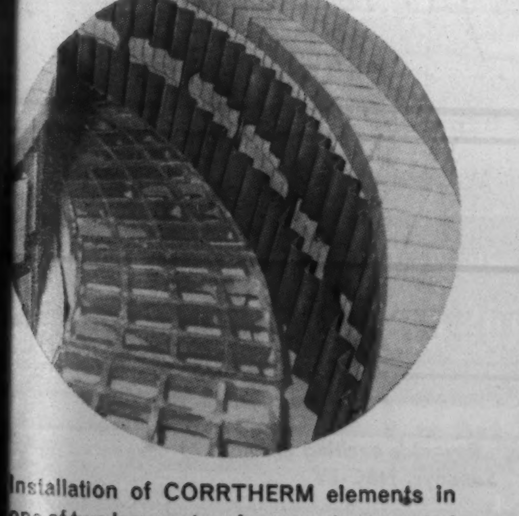
Durability—watts density at all time low. Element practically indestructible.



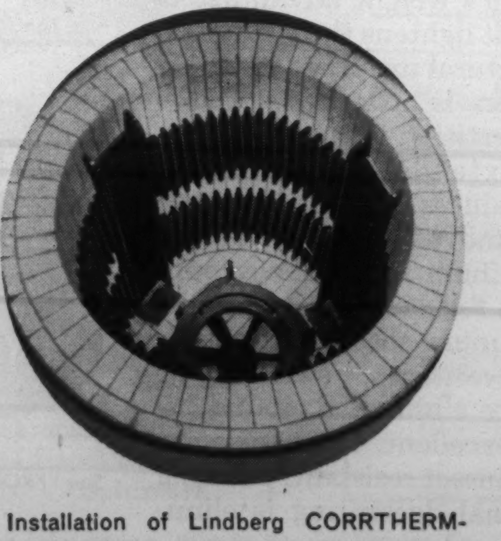
This shows how the new Lindberg CORRTHERM electric heating element fills the furnace with walls of glowing heat. Note also that CORRTHERM is conveniently hung from simple brackets requiring no complicated connections or construction.

CORRTHERM is an exclusive Lindberg development created in Lindberg laboratories by Lindberg metallurgists and engineers. To find out how its advantages can be applied to your heat-treating processes consult your nearest Lindberg Field Representative. (Look in classified phone book.)

LINDBERG ENGINEERING COMPANY
2451 West Hubbard Street, Chicago 12, Illinois
Los Angeles Plant: 11937 Regentview Ave., at Downey, California

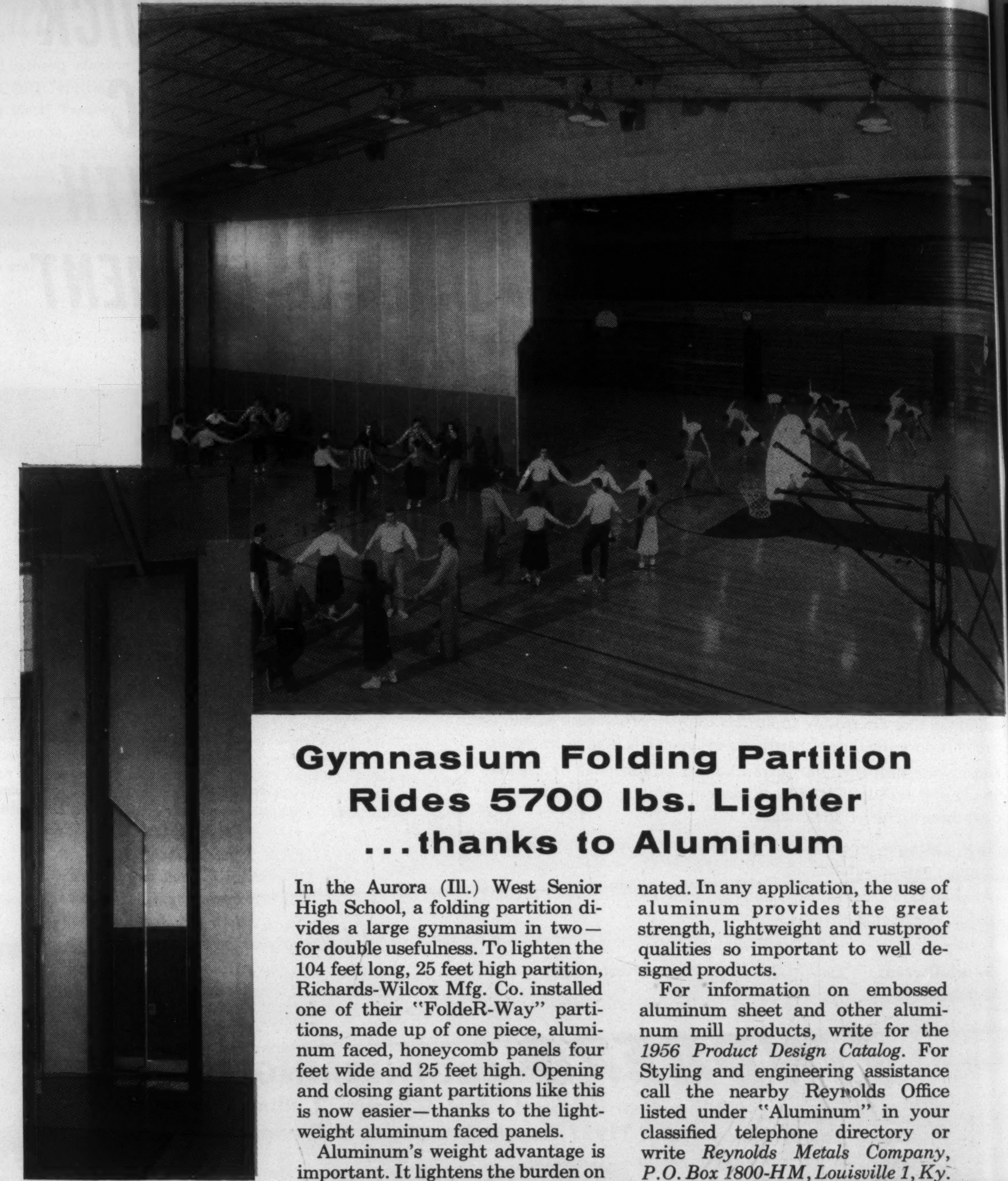


Installation of CORRTHERM elements in one of two large rotary furnaces just erected in the field by Lindberg's associate company, Lindberg Industrial Corporation.



Installation of Lindberg CORRTHERM-equipped carburizing pit-type furnace in plant of Lindberg Steel Treating Co., Melrose Park, Ill.

Safety! Extremely low voltage makes CORRTHERM elements completely safe. Let operator or work load bang it if they will. Neither element nor operator will be hurt.



Gymnasium Folding Partition Rides 5700 lbs. Lighter ...thanks to Aluminum

In the Aurora (Ill.) West Senior High School, a folding partition divides a large gymnasium in two—for double usefulness. To lighten the 104 feet long, 25 feet high partition, Richards-Wilcox Mfg. Co. installed one of their "FoldeR-Way" partitions, made up of one piece, aluminum faced, honeycomb panels four feet wide and 25 feet high. Opening and closing giant partitions like this is now easier—thanks to the lightweight aluminum faced panels.

Aluminum's weight advantage is important. It lightens the burden on ceiling structural members to which the partition is attached. And—when the partition is automatically folded or extended—aluminum's lightness reduces the load on the motor that moves it.

The aluminum faced honeycomb panels (with finishes embossed right in the aluminum sheet) offer other distinct advantages; swelling or shrinking are eliminated, sound insulation is excellent, the panels are vermin and insect resistant, painting and additional decorating is eliminated. In any application, the use of aluminum provides the great strength, lightweight and rustproof qualities so important to well designed products.

For information on embossed aluminum sheet and other aluminum mill products, write for the *1956 Product Design Catalog*. For Styling and engineering assistance call the nearby Reynolds Office listed under "Aluminum" in your classified telephone directory or write *Reynolds Metals Company, P.O. Box 1800-HM, Louisville 1, Ky.*

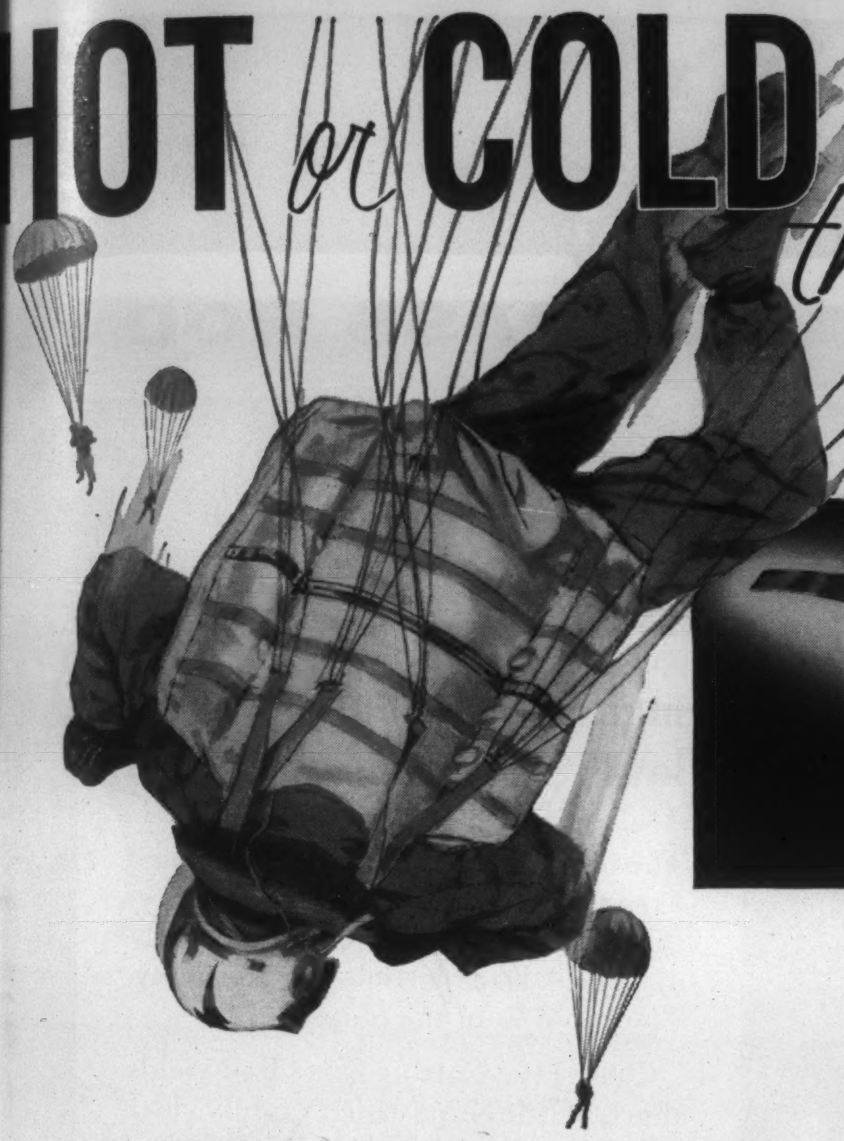
The Finest Products
Made with Aluminum
are made with
REYNOLDS ALUMINUM

See "FRONTIER", Reynolds exciting dramatic series, Sundays, NBC-TV

For more information, turn to Reader Service Card, Circle No. 559

HOT *or* COLD *these chutes WORK...*

THANKS TO *a special* STAINLESS STEEL!



Courtesy: Switlik Parachute Co., Inc.
John Evans' Sons, Inc.

In the sweltering tropics or sub-zero north, these new Navy parachutes give fool-proof service . . . thanks to the properties of a newly developed stainless steel.

Lighter and far more compact than conventional models—these chutes depend on springs channeled in the fabric—to exert tension when the chute is packed, then provide split-second opening when the rip cord is pulled. Initial designs called for springs of carbon steel until problems of corrosion, and embrittlement from sub-zero temperatures revealed the need for a more suitable steel.

Frasse engineers, invited to collaborate, recommended 17-7 PH—a precipitation hardening stainless grade that provided the required resistance to corrosion and embrittlement . . . made possible a single low temperature heat treatment with practically no distortion. Net result—a problem solved, a more durable, safer product, and 20% reduction in fabricating cost.

New steels and new uses for established grades are the continuing study of Frasse engineers. Consult them on your next steel problem—chances are they can recommend a steel to save money, increase production or improve your product. There's no obligation. Just call or write your nearest Frasse office.

Call FRASSE 1st
for STAINLESS STEEL

Bars
Strip
Wire
Sheets
Tubing
Valves
Plates
Pipe
Fittings

Want to know more about

STAINLESS?

This new Frasse brochure contains data on 16 different types and points up the benefits of each. Fabricating data and application hints are included. Simply fill in the coupon below for your copy today.

FRASSE
Stainless Steels

Peter A. Frasse & Co., Inc.
(use address nearest you)

Please send me your new brochure containing data on stainless steel.

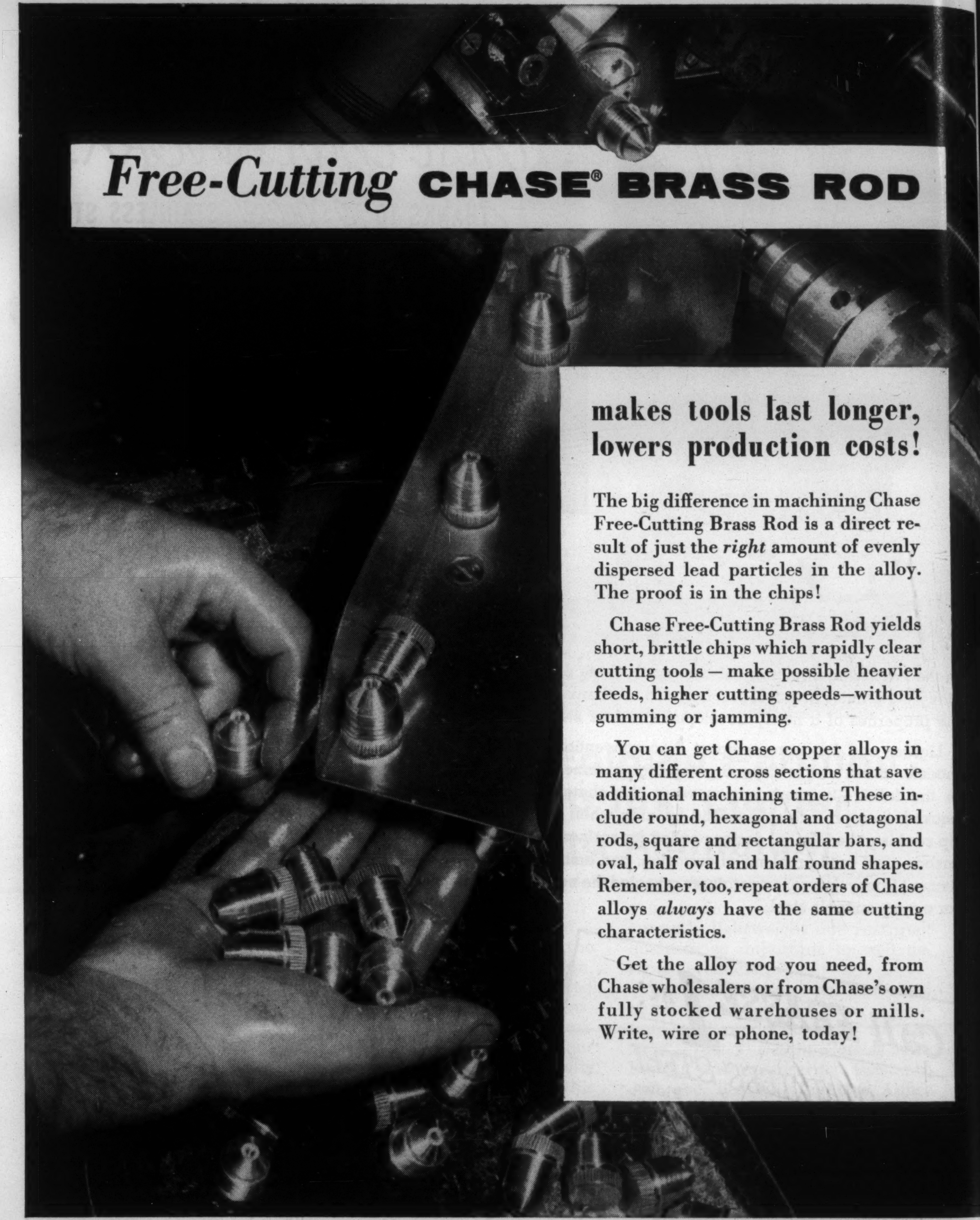
Name________________ **Title**________
Firm________________________
Address______________________

61 LA

Peter A. Frasse & Co., Inc.

New York 13, N. Y. • 17 Grand Street, WAlker 5-2200
Philadelphia 29, Pa. • 3911 Wissahickon Ave., BAldwin 9-9900
Buffalo 7, N. Y. • P. O. Box K, Sta. B, BEdford 4700
Syracuse 1, N. Y. • P. O. Box 1267, SYracuse 73-5241
Hartford 1, Conn. • P. O. Box 1949, CHapel 6-8835
Lyndhurst **Rochester** **Baltimore**

For more information, turn to Reader Service Card, Circle No. 381



Free-Cutting CHASE® BRASS ROD

makes tools last longer, lowers production costs!

The big difference in machining Chase Free-Cutting Brass Rod is a direct result of just the *right* amount of evenly dispersed lead particles in the alloy. The proof is in the chips!

Chase Free-Cutting Brass Rod yields short, brittle chips which rapidly clear cutting tools — make possible heavier feeds, higher cutting speeds—without gumming or jamming.

You can get Chase copper alloys in many different cross sections that save additional machining time. These include round, hexagonal and octagonal rods, square and rectangular bars, and oval, half oval and half round shapes. Remember, too, repeat orders of Chase alloys *always* have the same cutting characteristics.

Get the alloy rod you need, from Chase wholesalers or from Chase's own fully stocked warehouses or mills. Write, wire or phone, today!

NEW CHASE ROD and WIRE MOVIE "IN THE CHIPS"
Contact your nearest Chase Warehouse or Sales Office now to arrange for a loan of this informative film for showing in your own organization. Write on your Company letterhead.

Chase®
BRASS & COPPER CO.
WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

The Nation's Headquarters for Brass & Copper (†sales office only)

Atlanta
Baltimore
Boston
Charlotte†
Chicago
Cincinnati
Cleveland
Dallas
Denver
Detroit
Grand Rapids†
Houston
Indianapolis
Kansas City, Mo.
Los Angeles
Milwaukee
Minneapolis
Newark
New Orleans
New York
Philadelphia
Pittsburgh
Providence
Rochester†
St. Louis
San Francisco
Seattle
Waterbury

For more information, turn to Reader Service Card, Circle No. 369

For more information, Circle No. 535 ➤

Whether it's **CRASH HELMETS OR TOTE BOXES**

KEY-TOPS OR TRAYS – DRIP PANS OR PUSH BUTTONS . . .

AMERICAN IS YOUR ANSWER

FOR PRECISION MADE PLASTIC PARTS

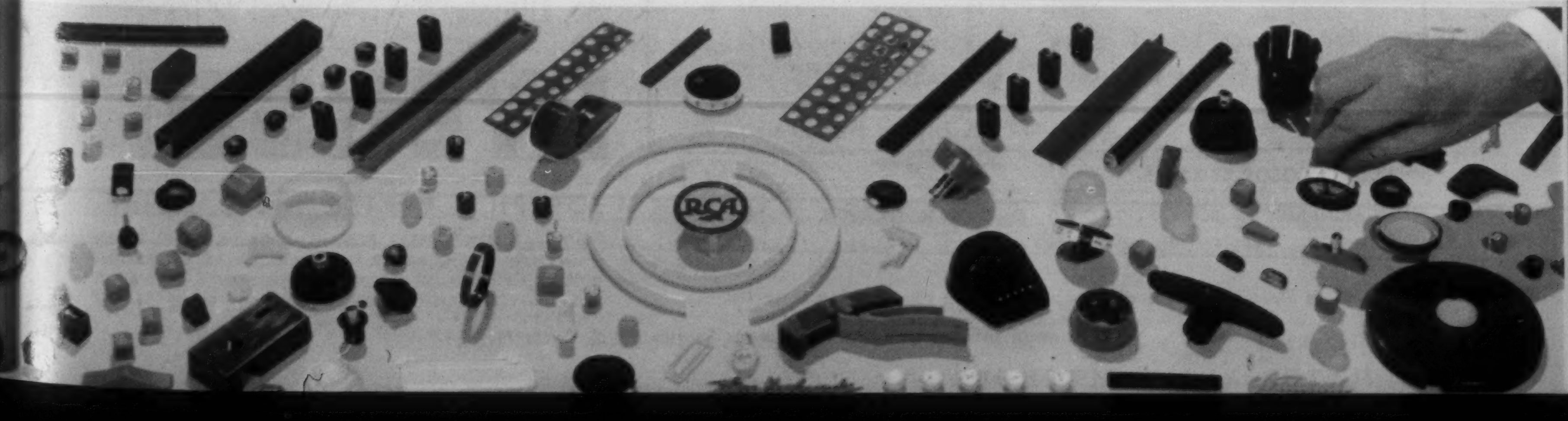
Whatever your industry or plastic part requirements, American's your answer. One of the nation's oldest and largest manufacturers of plastics, American offers facilities for injection, compression, extrusion, double-shot injection molding and low pressure and vacuum assisted molding. American's ultra-modern equipment can mold most types of plastics, including cellulose acetate and butyrate, polystyrene, acrylics, reinforced fibreglass and copolymers. American's giant plant can handle every stage of manufacture from design to mass production. Regardless of whether your plastic problem is clear-cut or complex . . . regardless whether your needs are small or large, call upon American for the economical, quality answer. Write direct for further information today. Address Dept. AA

A P C
PRECISION MADE

AMERICAN PLASTICS CORPORATION

A Subsidiary of Heyden Chemical Corporation
EXECUTIVE OFFICES: 342 MADISON AVENUE, NEW YORK 17, N. Y.

Plastics Production Partner of America's Most Progressive Manufacturers



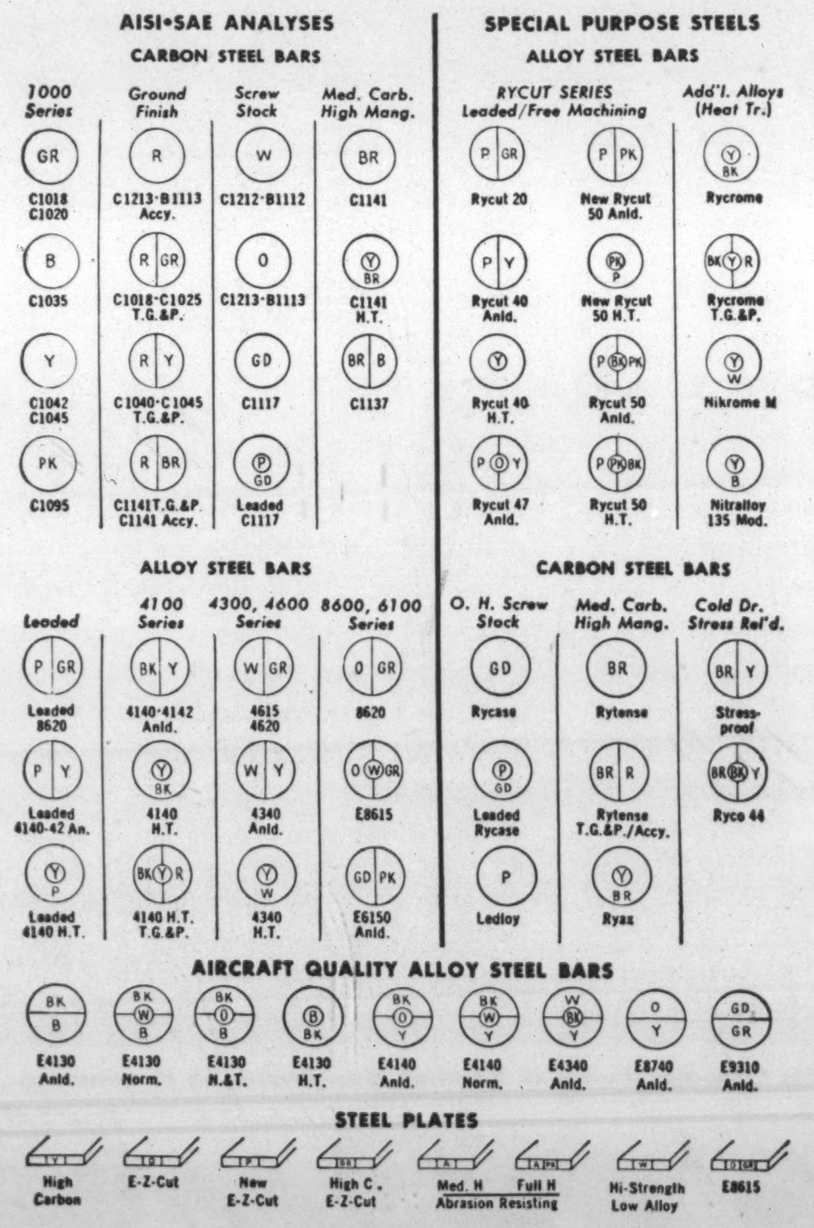
NEW COLOR CODE for steel identification

KEY TO COLOR SYSTEM

COLOR		CARBON STEEL BARS		ALLOY STEEL BARS		
GREEN	●	C 1018 · C 1020	◑	Under .30 Carbon		
BLUE	●	C 1035	◑	.30 to under .40 Carb.	◉	Heat Treated
YELLOW	●	C 1042 · C 1045	◑	.40 to under .50 Carb.	◉	
PINK	●	C 1095	◑	.50 Carbon and over	◉	
PURPLE	●	Ledloy (Solid Purple) Lead Added (Purple Dot)	◐	Rycut Series/Leaded		
BLACK			◐	4100 Series		
WHITE	●	C 1212 · B 1112	◐	4300 and 4600 Series		
ORANGE	●	C 1213 · B 1113	◐	8600 and 8700 Series		
GOLD	●	Low Carbon—High Mang.	◐	6100 and 9300 Series		
BROWN	●	Med. Carbon—High Mang.				
RED	●	C 1213 Accy. Stock (Solid Red) Sp'l. Gound Finish (Half Red)	◐	Special Ground Finish		

NEW RYERSON STEEL COLOR CODE

1. Single colors are for Carbon and Carbon-Manganese steels. 2. The Carbon colors Green, Blue, Yellow and Pink define Carbon content. 3. Centered dots of these Carbon colors indicate heat treated condition. 4. Other dots identify additional characteristics. 5. Red means Special Ground Finish. 6. Other colors designate related groups of steel. (See key above.)


AISI•SAE ANALYSES
CARBON STEEL BARS
1000 Series
Ground Finish
Screw Stock
Med. Carb. High Mang.
GR
C1018 C1020
B
C1035
Y
C1042 C1045
PK
C1095
R
C1213·B1113 Accy.
R GR
C1018·C1025 T.G.&P.
R Y
C1040·C1045 T.G.&P.
R BR
C1141T.G.&P. C1141 Accy.
W
C1212·B1112
O
C1213·B1113
GD
C1117
P GD
Leaded C1117
BR
C1141
Y BR
C1141 H.T.
BR B
C1137
SPECIAL PURPOSE STEELS
ALLOY STEEL BARS
RYCUT SERIES Leaded/Free Machining
Add'l. Alloys (Heat Tr.)
P GR
Rycut 20
P PK
New Rycut 50 Anld.
Y BK
Rycrome
P Y
Rycut 40 Anld.
PK P
New Rycut 50 H.T.
BK Y R
Rycrome T.G.&P.
Y
Rycut 40 H.T.
P BK PK
Rycut 50 Anld.
Y W
Nikrome M
P O Y
Rycut 47 Anld.
P PK BK
Rycut 50 H.T.
Y B
Nitralloy 135 Mod.
ALLOY STEEL BARS
Leaded
4100 Series
4300, 4600 Series
8600, 6100 Series
P GR
Leaded 8620
P Y
Leaded 4140-42 An.
Y P
Leaded 4140 H.T.
BK Y
4140·4142 Anld.
Y BK
4140 H.T.
BK Y R
4140 H.T. T.G.&P.
W GR
4615 4620
W Y
4340 Anld.
Y W
4340 H.T.
O GR
8620
O W GR
E8615
GD PK
E6150 Anld.
CARBON STEEL BARS
O. H. Screw Stock
Med. Carb. High Mang.
Cold Dr. Stress Rel'd.
GD
Rycase
P GD
Leaded Rycase
P
Ledloy
BR
Rytense
BR R
Rytense T.G.&P./Accy.
Y BR
Ryax
BR Y
Stress-proof
BR BK Y
Ryco 44
AIRCRAFT QUALITY ALLOY STEEL BARS
BK B
E4130 Anld.
BK W B
E4130 Norm.
BK O B
E4130 N.&T.
B BK
E4130 H.T.
BK O Y
E4140 Anld.
BK W Y
E4140 Norm.
W BK Y
E4340 Anld.
O Y
E8740 Anld.
GD GR
E9310 Anld.
STEEL PLATES
Y
High Carbon
O
E-Z-Cut
P
New E-Z-Cut
BR
High C. E-Z-Cut
A
Med. H
A PK
Full H
Abrasion Resisting
W
Hi-Strength Low Alloy
O GR
E8615

COPYRIGHT 1956 JOSEPH T. RYERSON & SON, INC.

KEY TO COLOR SYMBOLS:

A—ALUMINUM
BK—BLACK
GD—GOLD
O—ORANGE
PK—PINK
W—WHITE
B—BLUE
BR—BROWN
GR—GREEN
P—PURPLE
R—RED
Y—YELLOW

For Stainless steels and other products, see your Ryerson Stock List

More logical system aids quality control

Accurate identification of steel—always a point of paramount importance with Ryerson—now becomes even more meaningful than before with the introduction of a new system of color marking.

Based on logical groupings of related types of steel, this new Ryerson color code is easy to understand, remember, and use. It strengthens still further the rigid program of quality control that for years has guarded the known high uniform quality of Ryerson Certified Steel.

Here's how the system works:

1. Single colors are used for standard Carbon and Carbon Manganese Steels.
2. The colors GREEN, BLUE, YELLOW AND PINK always define Carbon content.
3. Centered dots of these Carbon colors always indicate the heat treated condition.
4. Centered dots of other than Carbon colors identify characteristics other than analysis, carbon content or the heat treated condition.
5. PURPLE, BLACK, WHITE, ORANGE, GOLD and BROWN each designate a related group of steels.
6. RED marking of any kind always indicates Special Ground Finish.

If you do not already have this new steel identification chart, we will be glad to send a copy (printed in full color) for your Ryerson Stock List. Call or write your nearby Ryerson plant, or write Box 8000-A, Chicago 80, Illinois.

RYERSON

JOSEPH T. RYERSON & SON, INC.

PLANTS AT: NEW YORK · BOSTON · WALLINGFORD, CONN.
PHILADELPHIA · CHARLOTTE, N. C · CINCINNATI · CLEVELAND
DETROIT · PITTSBURGH · BUFFALO · CHICAGO · MILWAUKEE
ST. LOUIS · LOS ANGELES · SAN FRANCISCO · SPOKANE · SEATTLE

For more information, turn to Reader Service Card, Circle No. 547

One point of view

Industry-Wide Materials Qualification

There are few users and suppliers of materials today who aren't faced with the problem of qualification testing. Before users place an order, they must be assured that the supplier can produce materials that will meet their specifications. Either each user must run tests on the materials or the supplier must prove his material to each user, separately. Either way results in excessive duplication of effort.

Perhaps the solution to the problem is the plan offered by Charles M. Miller, Materials Engineer at Northrop Aircraft, in the April issue of the *SAE Journal*. (See also M&M, Apr '56, p 13.) He proposes that a materials qualification agency be set up to establish and maintain approved materials lists. Such lists would be based on test data obtained either by the agency or by established laboratories engaged by the agency. Both users and suppliers could submit materials for approval. The company submitting the material would pay a fee to cover the costs of testing.

An approval or certification by such a central qualification agency would indicate that the material could be produced to specification and, therefore, no further qualification testing by individual companies would be required. But a certification would be no guarantee of the quality of material actually purchased or delivered. Each user would still have to perform regular acceptance tests on incoming materials.

Government procurement agencies have been using such a plan successfully for a number of years. The plan is based on Qualified Products Lists. These lists include the names of suppliers whose materials or products have passed specified qualification tests and are eligible for purchase without further qualification testing. Certification of electrical and electronic equipment by the Underwriters Laboratory is another example of industry-wide qualification procedures.

Mr. Miller is recommending the plan specifically for the aircraft industry, and the Society of Automotive Engineers is now canvassing its members to get their reactions on the matter. However, there is no reason why the same basic idea would not be workable in many other product manufacturing industries.

Perhaps the best equipped organization for establishing and administering a central qualification agency serving all of industry is the American Society for Testing Materials. It is an impartial society composed of both materials users and suppliers. The scope and nature of the ASTM's present work and its experience with testing and specifications eminently suit this group for the job.

The need for a central qualification agency is clearly evident. The ASTM would be doing industry a great service if it would take hold of this idea and see what can be done.

General Electric Co.

***Irradiation** is now commercially applied only to polyethylene.*

Highlights of

Progress in Plastics

in materials,
in engineering data,
in applications

by Malcolm W. Riley,
Associate Editor, Materials & Methods.

In the two years since the 6th Plastics Show, engineers and designers have benefited from an increasingly basic approach taken toward plastics as engineering materials. Here are the high spots in developments in this diversified field.

■ The plastics industry is getting basic. In the past two years, development work has concentrated more on understanding and modifying resins and applying them intelligently than on producing entirely new materials.

The major developments have involved alteration of resin production processes and alteration of fabrication methods to get improved end properties. Also, the blending of resins with other materials to obtain desired properties has increased.

Plastics engineering data are slow in accumulating primarily due to lack of reproducibility of materials, and lack of standardization of test methods and interpretation. But standards, always slow in developing, are being established, and there is some evidence that a greater percentage of research and development money is being spent on basic research rather than on empirical testing only.

As a result of greater understanding of plastics materials and their engineering properties, plastics are being used more and more as structural materials. Applications are becoming more functional. Though the engineering information on most materials is far from complete, many of the gaps have been filled.

Materials

Polyethylene

Probably the most widely publicized advance in thermoplastics has been the development of high density (also called linear or low pressure) polyethylenes. With the advent of these materials and others more recently developed by Du Pont and ICI, polyethylene resins with densities ranging from 0.911 to 0.96 g per cc will soon be available to engineers.

Density is a measure of crystallinity which affects stiffness and heat resistance, and to a lesser extent, tensile and yield strength, elongation, hardness and other properties. Generally, as density increases stiffness and temperature resistance increase, as well as tensile and compressive strengths. Elongation and impact strength decrease. The new materials have boosted temperature resistance available in polyethylene to about 260 F and stiffness moduli up to a maximum of 140,000 psi.

The break-through into the high density field was accomplished independently by Karl Ziegler of Germany and the Phillips Chemical Co. in this country. Each developed a method of polymerizing ethylene at low pressures (under 500 psi) using metallic catalysts, as opposed to the conventional high pressure method using oxygen as a catalyst. Initial conjecture on low pressure polymerization systems indicated that eventually costs of materials produced would be lower than those of materials produced by high pressure systems. But lower costs are complicated by catalyst extraction—a problem that may prove tough to whip.

Heterogeneous polymerization

Potential application of the new "low pressure" production method is much wider than the initial flurry over polyethylene indicates. It opens the door on the so-called heterogeneous phase of polymerization as opposed to the conventional homogeneous phases. The method shows good potential for polymerizing all types of addition polymers such as vinyls, styrene, propylene and butylene, and alcohols. G. Natta of the Milan Polytechnic Institute is currently working under the auspices of Montecatini on the polymerization problems involved in this method. The first broad interest expressed in this country, has been the recent announcement by M. W. Kellogg of a Phillips license for the purpose of studying production of the whole polyolefin family of plastics.

Irradiation

Another important development in thermoplastics, immediately applicable to polyethylene, is irradiation of polymers. The broad subject of effects of irradiation on organic polymers is being studied, but most commercial work has centered on polyethylene. Its effects on polyethylene are: 1) an ordinarily thermoplastic material becomes an infusible thermoset which exhibits form stability at temperatures up to 350 F; 2) seems to improve dielectric strength at 230 F and up; 3) improves resistance to stress-cracking; 4) the material becomes elastomeric at elevated temperatures; and 5) improves solvent resistance at elevated temperatures.

Limitations of irradiated polyethylene are: 1) it cannot be molded or extruded; it must first be formed, then irradiated; 2) shapes are limited in section thickness and color; and 3) it is not much stronger at room temperature, nor is it more resistant to heat-aging than non-irradiated polyethylene.

Currently it is being produced by G-E as tape; by Anchor Plastics as extruded tubing, rods and other shapes; and by American Agile as laboratory-ware such as beakers.

Thermoplastic sheet

Developments in both materials and forming methods account for the growth of interest in thermoplastic sheet. Replacing cast or calendered sheet with relatively low cost extruded sheet has allowed use of termoplastic sheet in applications previously uneconomical. At the same time, the development of automatic, rapid cycle forming machines has made sheet molding more practical for longer range production. All the methods have low forming pressures in common, thus low-cost molds and equipment. The most commonly used materials are polystyrenes and styrene copolymers, cellulose acetate, cellulose acetate butyrate, vinyl chloride-acetate copolymers, rigid polyvinyl chloride and the acrylics.

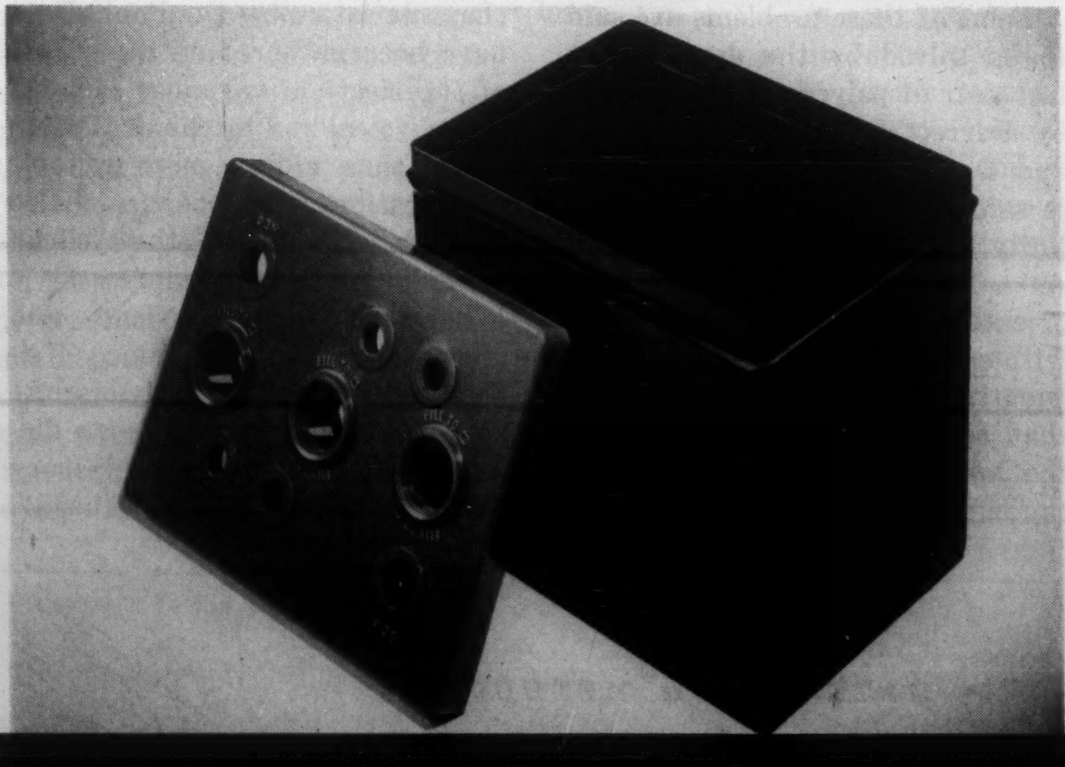
Polystyrene

Sometimes called the "pig iron" of the plastics industry, polystyrene has become glamorous. Copolymers such as styrene-acrylonitrile; "alloys" such as styrene-acrylonitrile-butadiene and rubber-styrene copolymer blends; oriented polystyrene; and substituted styrenes such as polymethylstyrene and its copolymer, methylstyrene-acrylonitrile all are aimed primarily at improving the major drawbacks of polystyrene, i.e., brittleness and poor resistance to temperatures.

The styrene-acrylonitrile-butadiene materials raise Izod impact values from the fractional level associated with polystyrene to as high as 6 ft-lb per in. of notch, while impact strength of the rubber-styrene copolymer alloys (combination of butadiene-styrene and styrene acrylonitrile) is raised to about 10 ft-lb per in. notch. Oriented (pre-stretched) polystyrene developed by Plax Corp. has an Izod impact

***Modifications of styrene** have provided wide ranges of properties. This high temperature, modified polystyrene battery case is said to have good heat resistance, impact strength and can be produced in a wide range of colors.*

General American Transportation Corp.



strength of about 3 ft-lb per in. of notch, but modulus of elasticity in tension is increased to 460,000 psi and tensile strength is boosted to about 10,000 psi. This compares with moduli ranging from 250,000 to 350,000 psi and tensile strength values of 2500 to 4500 psi for the modified styrenes.

The major break-through in temperature resistance would seem to be injection molding compounds of polymethylstyrene and its copolymer developed by American Cyanamid. The material is a substituted styrene polymer produced by the condensation of toluene and acetylene to form ditolylethanes, which are cracked to yield methylstyrene and toluene.

The material produced in this manner possesses a high percentage of the ortho isomer which contributes the most to heat resistance. ASTM heat distortion point (264 psi) is 203 F and the unstressed material is said to distort only 0.060 in. after 15 min in boiling water. Flexural modulus of elasticity is 400,000 psi for polymethylstyrene and 460,000 psi for the methylstyrene-acrylonitrile copolymer. Tensile strength is 6600 psi for polymethylstyrene and 9700 psi for the copolymer.

Polyamides

The major news in the nylon field is its wide use for mechanical parts (See Applications). However, there are several new nylons which offer greater design flexibility. There have always been a number of problems in molding nylon. It is highly susceptible to moisture and temperature conditions, and its shrinkage characteristics are erratic.

Some of these problems are said to be solved by the development last year of polycaprolactam nylon by Barrett Div., Allied Chemical and Dye. The material (type 6) is said to have controlled crystallinity and a high melt viscosity. As a result, the material can be oriented and extruded, or molded with ease. One of the major problems in extruding nylon has been that at temperatures just above the lowest working temperature, the material becomes so fluid that containment is a problem. The higher molten viscosity of polycaprolactam is said to overcome this problem. Du Pont is also reported to be coming up with an extrudable nylon resin. No details have been disclosed as yet.

Another nylon (type 8) is being produced and sold by Belding Corticelli Industries under a licensing agreement with Du Pont. Because it can be cross-linked by heat or acid, this material can be made thermoplastic or thermosetting. It can be used as a coating, a textile bonding resin, or as an extrusion resin.

A whole new family of polyamide resins, called Versamids, has been developed by General Mills. These materials are produced by the condensation of polymerized linoleic acid with polyamines. Versamids vary from hard, brittle high melting point (180-190 F) resins to relatively low viscosity fluids. Potential applications include various types of coatings, adhesives, casting, potting and laminating resins, and plastic solders and sealants. Most successful present use seems to be in combination with epoxies to form a thermosetting resin for plastics tooling. Versamids cure the epoxy, eliminating the need for toxic catalysts.

Fluorocarbons

The characteristics of tetrafluoroethylene (Teflon) make it a tricky material to form. Primarily it is molded by a process similar to powder metallurgy, i.e., compaction followed by a sintering operation. Main developments of interest to the end user have been the study of Teflon's basic characteristics by Du Pont. Data have been gathered on the effects of fabrication variables on the end physical and mechanical properties thus aiding more reliable specification of properties. Also methods of joining the "slick" material have been improved.

Both tetrafluoroethylene and monochlorotrifluoroethylene (Kel-F, Fluorothene and Polyfluoron) have been made available as dispersion coatings, both temporary (air-dry) and permanent (fused). These coatings now permit the engineer to apply the desirable characteristics of fluorocarbons to specific areas of a product where they are needed.

Other important developments are:

Development by M. W. Kellogg of a method of laminating Kel-F to glass cloth.

Development by Rogers Co. of a method of reinforcing Teflon with glass fibers to provide additional dimensional stability at elevated temperatures.

Development by M. W. Kellogg of a Kel-F rubber for critical service at high temperatures or under severe corrosive conditions.

Epoxies

There is still a great deal to be learned about the chemistry of curing epoxy resins. Conventionally, epoxies are cured with amine catalysts. However, these are toxic, and maximum heat distortion temperatures obtainable with amines is only about 350 F. Other types of hardeners have had varying degrees of success.

One of the most successful seems to be HET Anhydride, developed by Hooker Electrochemical Co. It is said to provide epoxy resins with strength and stiffness at high temperatures, fire resistance, high heat distortion temperatures (ASTM heat distortion points as high as 390 F), and generally excellent physical and mechanical properties. A glass cloth-reinforced laminate tested at 350 F is said to show a flexural strength of 73,500 psi and a modulus of elasticity of 3.33 x 10^6 psi. (HET Anhydride is also said to provide fire resistance when used with polyesters.)

Another major development has been "alloying" epoxies with other resins, such as phenolics, furanes, or with polysulfide liquid polymers. The purpose in the phenolics is to raise the epoxy's temperature resistance. The purpose in furanes is to reduce material costs. The polysulfide liquid polymer adds resilience to the otherwise brittle epoxy casting.

Epoxy molding compounds are now under developmental evaluation by Ciba Co., under license from Minneapolis-Honeywell Regulator Co., who developed the material.

Urethanes

A new family of resins, the urethanes, are now under intensive development. They are produced through the reaction of polyisocyanates and alkyds. Currently, urethane foams (See Foams Manual, p 143) are commercially available in rigid, semirigid and flexible compositions, with a range of properties. Urethane materials other than foams which are near the threshold of commercial production are: 1) wire varnish and other types of protective and insulating coatings; 2) adhesives; 3) potting compounds; and 4) elastomers. The Europeans, well ahead of the U.S., have been using isocyanate-base coatings and other materials for several years.

Premix molding

"Gunk molding" has been previously confined to small polyester parts. Being a low-cost, high production molding process, it is gaining wider use for forming large mass produced moldings where maximum strength is not needed. In general, the process offers the following advantages: 1) complex parts can be produced economically; 2) fast production is possible because of shorter press cycles; 3) preforms are not needed; 4) correct charge can be weighed out accurately; 5) proportions of resin, fiber and filler can be maintained closely; and 6) a great variety of inexpensive reinforcing materials can be used.

Silicones

Though silicones are not plastics, silicone resins are used as plastics materials, and several developments bear mentioning. 1) With the development of silicone laminating resins several years ago, increased interest has been paid to methods of fabricating reinforced silicone parts. In addition to hand lay up techniques, vacuum bag laminating may be used, provided the characteristics of the materials are considered in preparing the molding. 2) High pressure silicone laminates developed by Formica Co. have the temperature resistance associated with silicones. The materials are particularly recommended for printed circuit use.

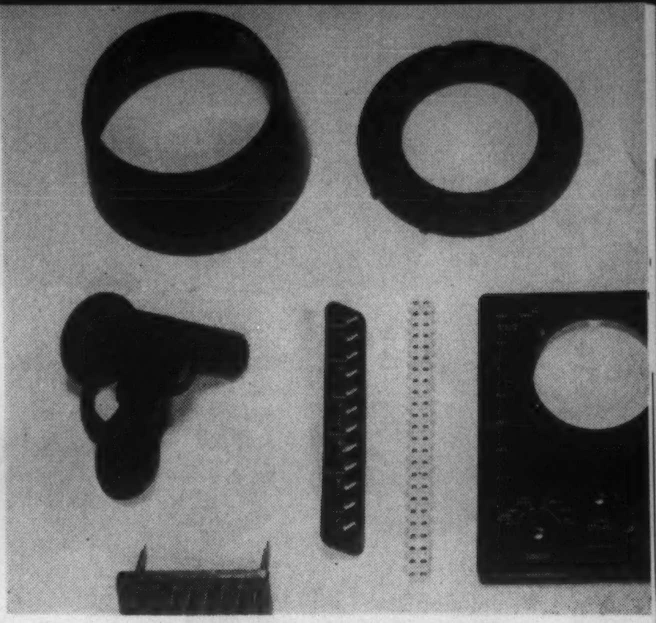
DAP

Diallyl phthalate molding compounds are new materials which have not been completely evaluated commercially. They are presently being produced by Mesa Plastics, Durez, and Acme Resin. Fillers used with various compounds include minerals, synthetic fibers, Orlon, Dacron, asbestos and glass. The materials are primarily of interest for their dielectric characteristics. They have good resistance to moisture and humidity, high dielectric strength, low dielectric loss, good arc resistance, and high dimensional stability.

Reinforcement

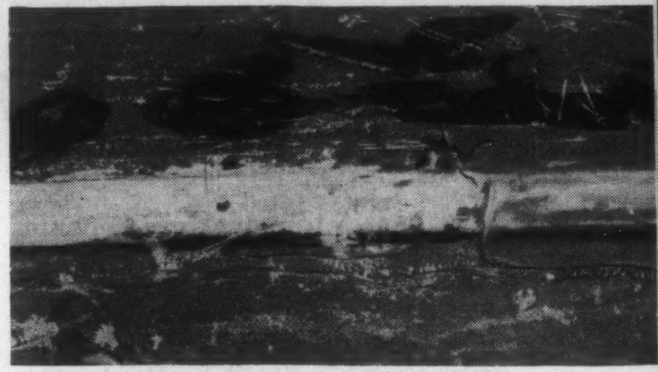
Glass has been the standby of the reinforced plastics industry. In the past two years there has been a wider diversification in forms in which it is being used. For low pressure laminates, resin-bonded mat and mechanically bonded mat have broadened the range of properties available in laminates. In molding compounds, in addition to chopped strand, the development of glass in flake form would seem to offer interesting possibilities. Work done to date indicates that flake can provide substantial improvements in electrical properties of polyesters, and improvements in strength and stiffness characteristics of polyethylene.

As a rule, finishes for glass cloth have been somewhat specialized, and a finish is selected on the basis of the resin used to impregnate the glass. An interesting development is the universal glass finish which can be used with polyesters, epoxies and phenolics. Announced by the Naval Ordnance Laboratory and called NOL 24, it is a halosilane finish, a product of the reaction between allyltrichlorosilane and resorcinol. Previously good strength characteristics had been obtained with epoxy and phenolic resins. Now success has been obtained with polyesters.



Mesa Plastics Co.

DAP molding materials *shown in electrical and electronic parts.*



Union Carbide and Carbon Corp.

Dynel overlay *provides improvements in abrasion, chemical and weather resistance of glass-reinforced plastics. Section of dinghy keel at right shows protection offered to glass-reinforced laminate (uncovered at left).*

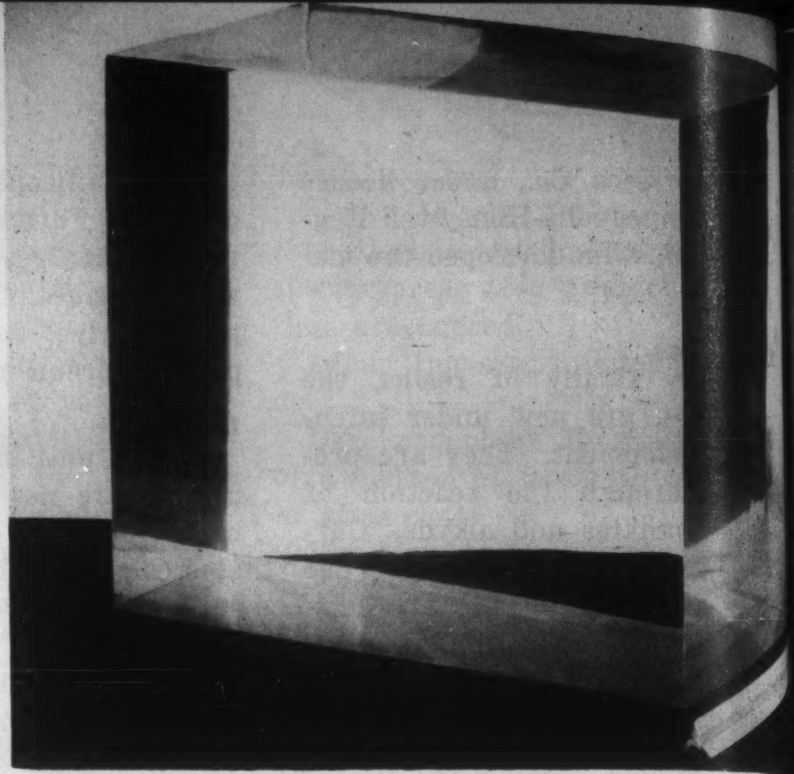
Largely due to the supply situation, asbestos has not found much use as a reinforcing material for low pressure laminates in this country. Most of the development work on asbestos to date has been in England, where it has been used successfully for some time. However, there has been increasing interest in this country in applications for asbestos, as well as for other non-glass reinforcing materials for low pressure laminates.

Advantages of asbestos in this application are: 1) better retention of strength at elevated temperatures (though asbestos laminates have somewhat lower strength at room temperature than glass); 2) better stiffness than glass at both room and elevated temperatures; 3) asbestos is readily bondable to other materials; 4) cost is less than glass.

Primary work has been with phenolics, though some has also

E. I. du Pont de Nemours & Co.

***Nylon** has been engineered into more and more bearing applications. Types shown illustrate possibilities.*



Cadillac Plastic and Chemical Co.

***Transparency of acrylics** is causing their wide use in optical applications. This cast acrylic sheet is 10 in. thick.*

been done on polyesters, epoxies and silicones. Preimpregnated felts are being produced by Turner Bros. Asbestos Co., and felts and papers are produced by Raybestos-Manhattan.

Other work on non-glass reinforcing materials in the low pressure laminate field has concentrated on synthetics such as acrylics, polyesters, acetates, rayon and nylon, and natural fibers such as sisal. The major advantage of synthetic fiber reinforcing would seem to be in improving chemical resistance, at sacrifice of strength.

Union Carbide and Carbon has done extensive research work on investigating use of Dynel as an overlay for glass to improve chemical and abrasion resistance in low pressure, and in some high pressure, laminates. The material in either cloth or non-woven form is laid up just as another layer of glass would be, impregnated, and the entire laminate cured. Possibilities of the material are graphically illustrated by immersing Dynel and glass fibers in boiling hydrochloric acid (15%) for 4 hr. After this time, glass roving suffers a 36.4% weight loss; with Dynel, weight loss is 1.7%.

An interesting development in reinforcing silicone rubber has been the development by G-E of a tear resistant material reinforced with Teflon. The Teflon is added as a powder during compounding. The shear action of the rolls breaks down the granules into long threads which reinforce the silicone rubber.

Foams

There has been a great deal of interest and some misinformation about plastics foams, or expanded plastics. The truth is that these materials are so new that there is relatively little engineering information available on them. The SPI has established a Cellular Plastics Division to help guide development of more information and standardization in the field.

Current commercial interest centers about the foamed polystyrenes, vinyls and urethanes. Other expanded resins which are available include phenolics, silicones, polyethylene, cellulose acetate, epoxy and urea formaldehyde resins. Complete information on foams is presented in this month's Manual on p 143.

Engineering Data and Standards

The greatest indication of the growing maturity of the plastics industry is the direction research work has taken in developing engineering data and standards. Originally most of the experimental work on plastics was of an empirical nature. Though there is still a great deal of this necessary work, there is evidence that an increasing amount of experimental work is aimed at studying basic characteristics of materials. Since the nature of some plastics makes reproducibility of properties difficult, and test procedures as a whole are somewhat unsatisfactory, this work is vital.

Time and temperature dependent properties

With the increased use of plastics in structural applications, the need for information on time-dependent properties of plastics has increased. Standard data sheets listing static properties of materials are insufficient for confident engineering and design. More workers are currently concentrating on study of creep (cold flow), stress-rupture, and fatigue characteristics of plastics, particularly reinforced plastics. Though several papers have been delivered on the subject, unfortunately there is little definitive data available as yet.

Illustrating this trend in research is work done by Fibercast Corp. on stress, creep and other time dependent characteristics of reinforced plastic pipe. Their work has emphasized the importance of the "glue line" area and the adherence of the resin to the glass. In a paper delivered before the Annual Technical Conference of the SPE this year, H. D. Boggs pointed out that their work led them to the following conclusions on reinforced laminates: 1) resins control the long term strengths; 2) glass reinforcement operates to reinforce the resin up to the point at which the glass-to-resin bond fails; 3) factors influencing creep are stress, time and temperature, an increase in any one of which will accelerate creep to failure; and 4) for sound structural laminates, resins must have a modulus of elasticity in excess of 3,500,000 to 4,500,000 psi, ability to elongate 0.9 to 1.2% without failing or reaching their elastic limit, and retain adhesion and a modulus of 2,500,000 psi minimum at 200 F. Also, the resin must have controlled cross-linking to prevent residual shrinkage stresses in the resin body.

Difficulties due to lack of reproductibility in materials were pointed out by workers at Westinghouse reporting on preliminary work on creep characteristics of reinforced laminates at temperatures up to 600 F. The work covered phenolic, melamine, silicone and polyester resins with glass, asbestos and cotton reinforcements. In their paper delivered before the Annual Technical and Management Conference of the Reinforced Plastics Div. of the SPI this year, H. R. Sheppard, Jr., and E. H. VanAntwerp pointed out the variability of reinforced plastics materials as indicated by wide variations in test results on samples of material obtained from the same sheet of material.

Test methods

Though there are a large number of tests which have been standardized by the ASTM, the major problem in the plastics field is determining what test results mean. Are they only valid on a comparative basis, or are they indicative of behavior of materials in actual use? Major developments in test techniques and test interpretation have been in modification of tests or combinations of tests to provide more realistic results.

A good illustration of this trend is Monsanto's work in toughness tests for plastics. They have developed a combination of tests for more accurately measuring "toughness" of injection molded styrene and similar materials. In brief, it consists of combining Izod tests with falling ball impact tests on tile specimens. Du Pont has advocated use of tensile impact testing as an inexpensive method of gathering more reliable impact strength data. The test consists of a modification of the Izod machine so that the sample is broken in tension. The method also has the advantage that the test sample need not be rigid, allowing tape or film to be tested on the same apparatus as rigid specimens.

Another illustration is the investigation by G-E of the Prot accelerated fatigue test as a method of determining endurance limits of plastics. Preliminary work with simple polymer systems seems promising.

Standards

Development of standards is always a slow process. However, in the last two years, the following commercial standards have been developed under SPI auspices:

Department of Commerce (Recorded voluntary standards of the trade).
CS197-54 Dimensions and Tolerances for Flexible Standard-Wall Polyethylene Pipe.
CS201-55 Rigid Polyvinyl Chloride Sheets.

National Electrical Manufacturers Association (NEMA)
Standards for General-Purpose Grade GPO-1 Polyester Glass-Mat Sheet Laminates. (Covers a general purpose grade laminate to be used for both mechanical and electrical applications.)

National Sanitation Foundation
Identification Program. (Program for applying NSF seal of approval to plastic pipe, thus identifying it for use in drinking water field.)

Proposed industry specifications and standards presently being developed by the SPI include:

Thermoplastic Pipe Div.:
Polyethylene pipe, 75 psi and 100 psi.
Solvent welded polyethylene pipe.
Polyvinyl chloride pipe.
Heavy duty Saran pipe.

Garden Hose Div.:
Garden hose standard on dimensions and tolerances and test methods to determine performance.

Thermoplastic Structures Div.:
Polyethylene sheet.
Fabricated materials specifications on fluorocarbons.

Cellular Plastics Div.:
Specifications and methods of test for polyvinyl chloride foam or copolymers thereof.
Industry performance standards and specifications on flexible and rigid urethane foams.

Applications

Greater understanding of the chemistry of plastics coupled with development of more reliable engineering data have contributed to the growth of plastics as structural materials. The most graphic examples are plastics pressure vessels, sandwich construction, bearings and pipe.

Pressure vessels

Developed by the Chemical Corp., pressure vessels of glass reinforced polyester resin are designed for operating pressures of around 2000 psi and minimum burst pressures of around 6000 psi. Main advantages they offer over metal are: 1) lighter weight for a given capacity; 2) greater variety of economical shapes; and 3) corrosion resistance. They also offer a good combination of impact strength, dimensional stability and resistance to weather and temperature extremes.

Major limitations on their use are: 1) without close control, heterogeneity of material can cause problems which become evident in end products, and 2) more specific engineering data on reinforced laminates are necessary for continuous production of reliable designs. Also under study are 1) use of various types of metal liners; 2) use of other forms of glass and of other reinforcing materials; and 3) use of other types of binder resins, such as epoxy.

Sandwich structures

Two components of sandwich panels can be constructed of various types of plastics materials. They are: 1) the core, which may be a plastics foam or reinforced plastics laminate in honeycomb form; and 2) the faces which may be of a variety of types of reinforced plastics laminates. Plastics cores have been combined with plastics laminate faces, or with metal, plywood or other types of sheet materials. On the other hand, plastics laminate faces have been combined with a variety of core materials.

The various possible combinations provide the engineer with a wide range of properties and characteristics. Some of the more important advantages available include: 1) good strength-to-weight ratio; 2) cost reduction; 3) simplified construction; 4) greater strength or stiffness; 5) thermal insulation; 6) fire resistance; 7) moisture or water resistance; and 8) vibration or sound deadening.

Possibly the most important application of plastics sandwich structures is in the aircraft field as a light weight strong material. Therefore, there has been increasing emphasis on improving the high temperature resistance of the material. Primary interest in higher temperature plastics sandwich structures (300-500 F range) has centered on the TAC-modified polyester, silicone, and phenolic resins. Polyesters are used as reinforced honeycomb or facings, the silicones either as reinforced facings, honeycombs or foam cores, and the phenolics either as high-pressure laminate facings or as foam cores.

Bearings

Nylon and Teflon have assumed an important place for themselves in the bearing field. A substantial amount of research and development work now permits reliable design of the materials from both the frictional and mechanical standpoint. Filled Teflon formulations have been developed to provide additional wear resistance to couple with Teflon's low coefficient of friction. To combine nylon's good frictional characteristics with the high dimensional stability of metals, an efficient method of coating metal parts with nylon has been developed independently by the Polymer Corp. and American Agile. The process consists of dipping preheated parts in a bed of nylon powder, which is agitated by pressurized air.

One of the most recent developments in the use of Teflon for bearings is an impregnated material developed by Glacier Metal Co., Ltd. of England. It consists of a steel backing with porous bronze face which is impregnated with Teflon, thus providing 1) a plastic surface with the desirable frictional characteristics as well as chemical and wear resistance, and 2) the high dimensional stability offered by the bronze.

Pipe

Use of plastics pipe has assumed large proportions in the last two years. The development of reliable fabricating methods and realistic engineering information has permitted sound designing of plastics pipe. Plastics of most commercial interest for pipe are polyethylene, rigid polyvinyl chloride (PVC), cellulose acetate butyrate and styrene-acrylonitrile copolymers. Use of vinylidene chloride (Saran) as structural pipe has decreased recently; however, it does have an established market as a pipe lining material. Glass-reinforced polyester and epoxy pipe is used where high working pressures and temperature resistance are required. Phenolic asbestos pipe is used where an extreme range of corrosion resistance properties and wide operating temperature range are necessary; however, it must be designed for lower working pressures. Other resins of interest are: 1) nylon; 2) tetrafluoroethylene (Teflon) though present costs are high; and 3) methyl methacrylate, used for special applications where transparency is desirable.

Other applications

Other important applications too numerous to discuss here are:

Reinforced plastics are being used for machine and instrument housings.

Expanding use of vinyl polymers and copolymers as sheet, film, foams, slush molded products, and plastisol coatings stems from refinements of formulation and improvement in mechanized fabrication methods. Methods of laminating vinyl sheet to metal, reinforced plastics and other materials permit combining the properties of vinyl with those of other materials.

Packaging with plastics film and sheet is finding ever-widening acceptance primarily due to improvements in forming and manufacturing techniques.

Optical clarity of cast acrylic materials is being used by replacing glass with acrylic in camera viewers and instrumentation of all types as well as in glazing applications.

Colorability of urea and melamine molding materials has expanded their use in saleable consumer items, such as tableware.

High dielectric characteristics of a variety of alkyd molding compounds has stimulated their use in molded parts in the electrical manufacturing industry.

References

The bulk of the information has been extracted from articles published in Materials & Methods over the last two years. Technical papers referred to in the text are:

Adams, C. H., Jackson, G. B., McCarthy, R. A., "Utility of Impact Testing as A Criterion of Toughness." Delivered before the 12th Annual Technical Conference of the SPE, Jan '56.

Boggs, H. D., "Long Term Strengths of Reinforced Epoxy Pipe." Delivered before the 12th Annual Technical Conference of the SPE, Jan '56.

Bragaw, C. G., Jr., "Tensile Impact: A Simple Meaningful Impact Test." Delivered before the 12th Annual Technical Conference of the SPE, Jan '56.

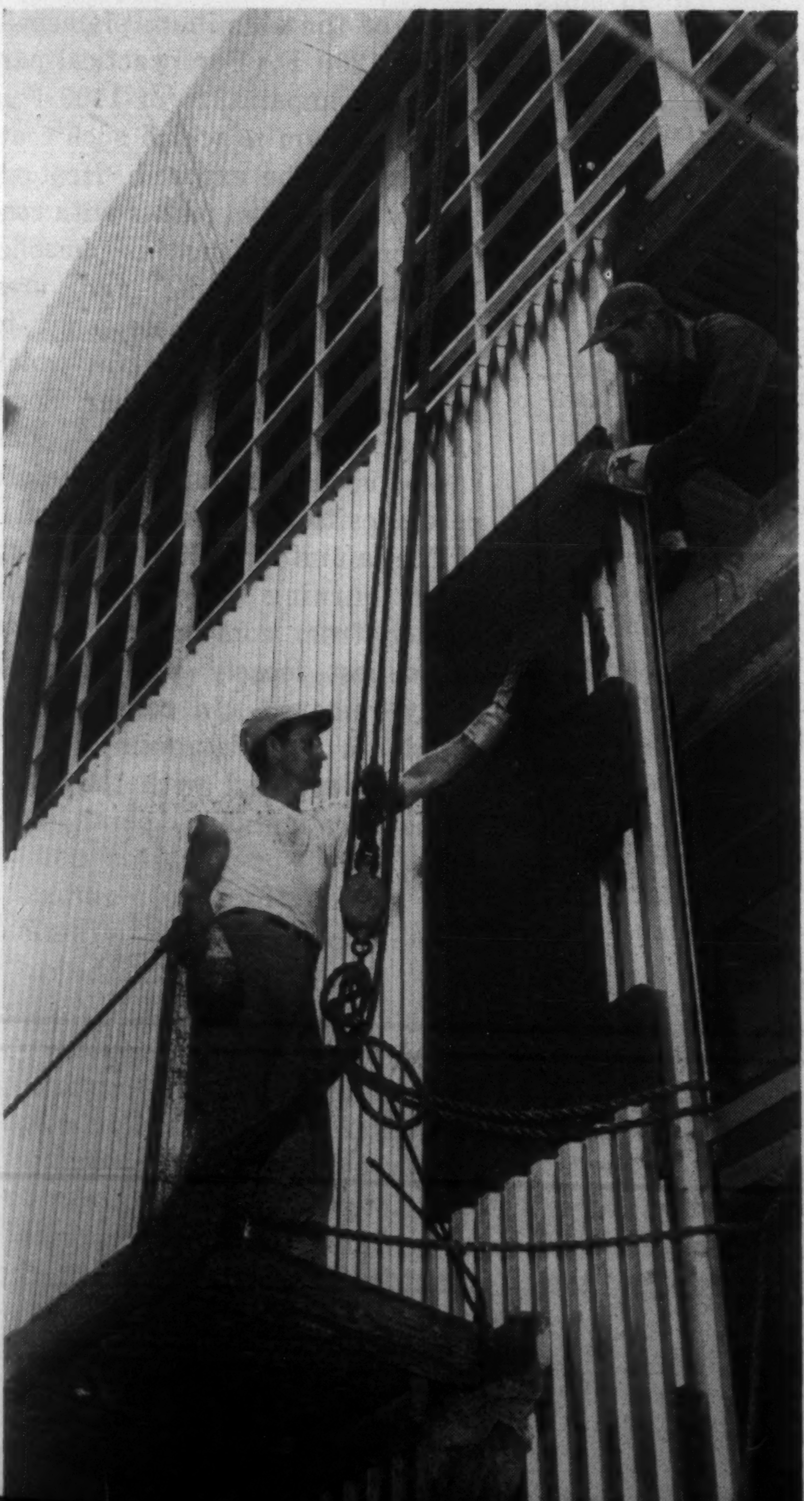
Lazar, L. S., "Use of the Prot Accelerated Fatigue Test to Predict Endurance Limits of Plastics." Delivered before 11th Annual Technical and Management Conference, Reinforced Plastics Div., SPI, Feb '56.

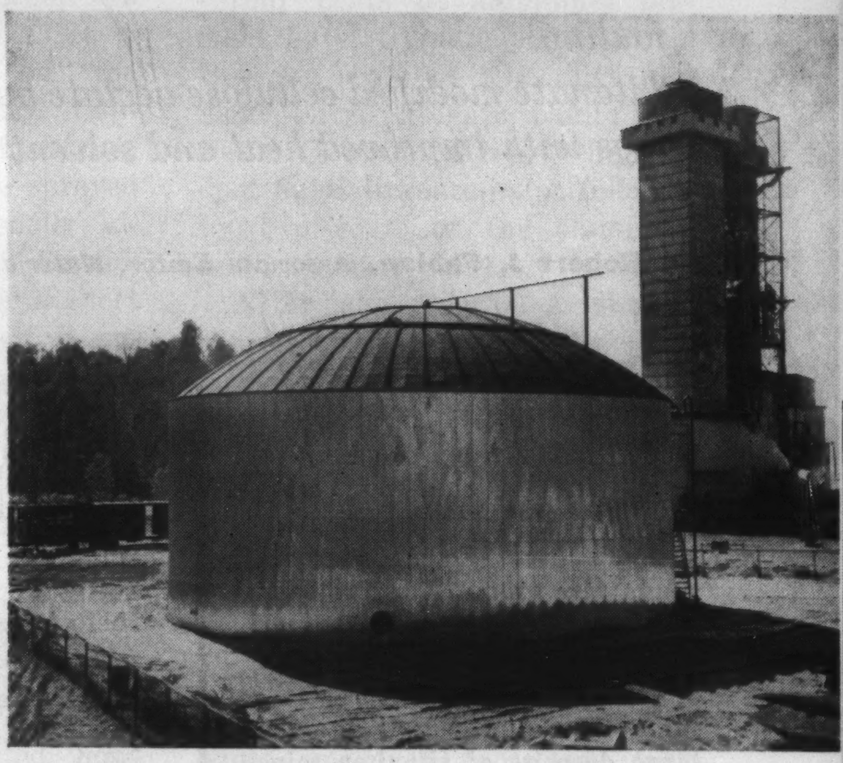
Sheppard, H. R., Jr. and Van Antwerp, E. H., "Creep Characteristics of Reinforced Plastics at Temperatures up to 600 F." Delivered before 11th Annual Technical and Management Conference, Reinforced Plastics Div., SPI, Feb '56.

Aluminum-cellular glass sandwich walls

Aluminum and cellular glass "sandwich" walls were used to construct a bottling plant for Duquesne Brewing Co. in Pittsburgh. Wall is only 3½ in. thick and yet has a heat transmission coefficient of 0.18. Foamglas blocks, made by Pittsburgh Corning Corp., were placed against the back up strip of aluminum ribbed siding and temporarily secured with Armstrong 340 cement. Facing aluminum sheet was set in place and holes drilled through it, the insulation, back up sheet and steel supporting members.

Sealed glass cells of the cellular glass are impervious to moisture and the ribs of the aluminum serve as miniature "chimneys" to carry off any condensation. The walls weigh 1.1 lb per sq ft and can be dismantled and rebuilt again for building additions.





Stainless steel stores chemicals

Stainless steel tank at Mississippi Chemical Corp. has made operations of its ammonium nitrate fertilizer plant more flexible. Tank, built by Chicago Bridge & Iron Co., is 78 ft in dia, 30 ft high and has a capacity of 25,000 barrels. Outside of tank is insulated with foam glass and the insulation is retained by light gage aluminum on the side walls. When prilling plant (right background) shuts down, tank stores ammonium nitrate, which permits continued processing of nitric acid into ammonium nitrate solution. Company selected stainless steel, because of its corrosion resistance to ammonium nitrate and the possibility of storing nitric acid in the tank.

New Titanate Coatings

Improve product heat and corrosion resistance

Significant properties of these new finishes include:

- *Aluminum-pigmented titanate paints capable of operating continuously at temperatures up to 1100 F.*
- *Zinc-pigmented titanate paints with marked resistance to atmospheric and salt water corrosion and marine fouling.*
- *Titanate modified cellulose acetate butyrate lacquer coatings with improved heat and solvent resistance.*

by Robert J. Fabian, *Associate Editor, Materials & Methods*

■ Concerted efforts directed toward exploiting the full potential of titanium and its compounds have resulted in the development of new coating materials outstanding for their heat and corrosion resistance. Aluminum-pigmented paints based on butyl titanate (a titanium ester) have proved serviceable at temperatures up to 630 F higher than conventional aluminum paints and have proved superior in many applications to aluminum-pigmented silicone paints. When applied to steel panels, zinc-pigmented butyl titanate coatings have provided corrosion-free operation after immersion in sea water for periods up to two years. Similarly, panels coated with zinc primer and aluminum finishing coats have shown no corrosion after 18 months immersion.

Heat resistant paints

One of the most significant applications of butyl titanate is its use as a vehicle or carrier in heat and corrosion resistant coatings containing aluminum pigments. The superior properties of these coatings derives from an entirely inorganic film formed by the products of hydrolysis of the ester that cements the pigment particles together. Hydrolysis begins immediately after the coating is applied and can be accelerated by exposure to heat. Principal applications to date include coatings for smoke stacks, kilns, breechings, fire doors and other applications where corrodible metal parts are exposed to continuous or intermittent high temperatures.

The butyl titanate aluminum coatings are most effective at temperatures above which ordinary aluminum paints are serviceable. The inorganic coating cannot burn off and is stable up to the melting point of the aluminum pigment—about 1200 F. For practical purposes a temperature of 1100 F is the maximum to which such coatings should be exposed. Heat resistant aluminum paints with conventional media such as phenolic, hydrocarbon, acrylic and urea resins are serviceable only to about 480 F, the point at which the coating begins to char. Some of the more recent silicone resins can be used to about 840 F before decomposition of the resin occurs.

The aluminum film remaining after burning off the organic matter from conventional paints is at best loosely adherent and easily removed. In contrast, the aluminum and titanium dioxide coating deposited with the butyl titanate aluminum paint possesses excellent adhesion and is removed only by severe abrasion. Outstanding resistance to thermal shock also characterizes the coating.

One inherent disadvantage of the aluminum titanate coating is that after being heated it is less resistant than organic coatings to moisture and salt water exposure. This effect can be minimized by careful control of the

Early Developments

The outstanding property of butyl titanate aluminum coatings is their resistance to high temperatures. Esters of titanium were prepared as far back as 1873, but they found little or no application until 1947 when Australian investigators, working to find new outlets for the large deposits of titanium minerals in their country, discovered that paints based on butyl titanate (an ester of titanium) possessed excellent heat and corrosion resistance.

Numerous applications have been found for these coatings both in Australia and England principally for chimney stacks, heater baffles, automobile mufflers, locomotive fire doors, outboard motor cylinder heads and underwater steel structures. A large number of foreign developments can be traced to the efforts of Peter Spence & Sons Ltd., sole manufacturers of butyl titanate in the United Kingdom. Principal suppliers in the U. S. include the Pigments Dept., E. I. du Pont de Nemours & Co. and Titanium Pigment Corp., a subsidiary of National Lead Co.

relative proportions of butyl titanate and aluminum, an optimum ratio being about 1:1. Generally, smaller quantities of the ester increase moisture protection. If aluminum paste is used then the ratio should be about 1:1.5 (titanate: aluminum) since the paste contains only about 65% aluminum.

To promote a good adhesive bond it is essential that all surfaces be thoroughly cleaned before painting. This is especially important because of the differential expansion that occurs between the base metal and surface coating when heat is applied. Wire brushing alone is not usually sufficient except only on slightly rusted surfaces. Flame cleaning followed by wire brushing has been found to give good results. If this does not work then it may be necessary to degas the metal at 700 F and follow with wire brushing and sanding and a wash in 10% nickel sulfate.

TYPICAL BUTYL TITANATE PAINT FORMULATIONS

Composition	Weight, %
ALUMINUM PAINT	
Aluminum flake (extra fine)	29.0
Butyl titanate polymer	31.0
10% ethyl cellulose toluene solution	5.0
Mineral turpentine	35.0
ZINC DUST PAINT	
Zinc dust (superfine, vaporized)	55.0
Wet-ground mica	2.5
Butyl titanate polymer	23.0
10% ethyl cellulose solution	2.5
Mineral turpentine	17.0
COPPER OXIDE ANTI-FOULING PAINT	
Cuprous or cupric oxide	23.0
Zinc dust (superfine)	27.0
Wet-ground mica	1.5
Butyl titanate polymer	33.0
10% ethyl celluose solution	1.5
Mineral turpentine	14.0

To obtain optimum film properties the dry film thickness per coat should not be more than 0.5 mil. It is particularly important that coatings be thin and uniform, and for this reason spray coating is usually recommended. Volatilization of the organic matter usually takes place when the article is put into service. It is not advisable to "burn off" too many coats simultaneously. Consequently, after the application of two brushed coats or one sprayed coat the surface is usually allowed to air dry for ½ hr and then heated at 750 F for a short time before the next coat is applied to remove all organic matter. The covering power of butyl titanate paints is of the same order as other aluminum paints —about 100 to 125 sq yd per gal

Protection, especially from atmospheric corrosion, depends on the total film thickness. Normally, one coat is sufficient for unexposed surfaces. Where severe corrosion is expected, however, three brushed or two syrayed coats are usually required.

Coatings are rather brittle and metal parts cannot be bent or formed without cracking the paint film. Flexibility for low temperature applications can be increased by the addition of small amounts of a suitable alkyd resin to the formulation.

Corrosion resistant paints

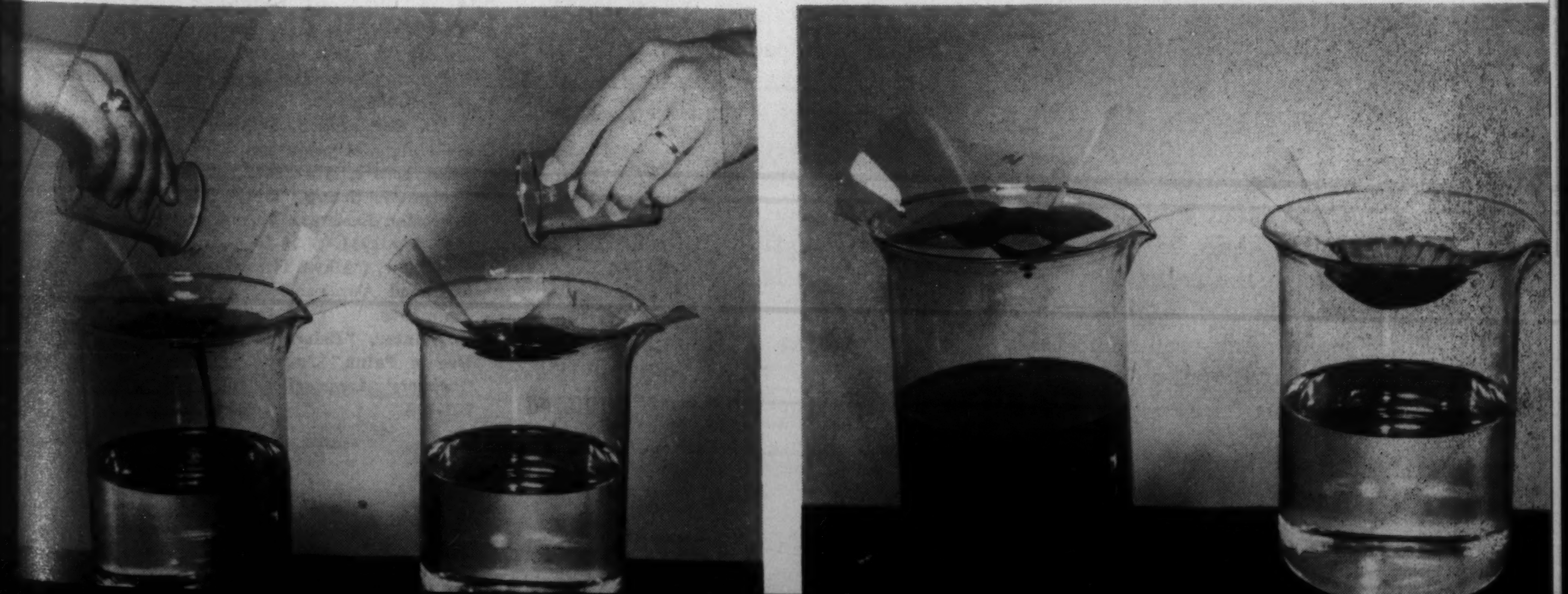
Good corrosion protection for outdoor applications has also been obtained with two coats of a zinc dust pigment butyl titanate primer followed by two coats of the aluminum pigment coating. In one test cited, the outside of a steel chimney stack that operates at 480 to 570 F was cleaned and the following paint systems applied to adjacent panels: Panel A —four coats of aluminum pigment butyl titanate paint; Panel B—four coats of zinc dust pigment butyl titanate paint; and Panel C—two coats of the zinc dust butyl titanate paint followed by two coats of the aluminum butyl titanate paint.

After six months A showed some corrosion. After 12 months A started to flake and B showed some corrosion. After 18 months most of the paint had disappeared from A, some corrosion showed on B, and C was still in excellent condition. No other paint previously used had lasted more than 12 months.

It should be noted that while the zinc-aluminum system provides improved protection from atmospheric corrosion, its heat resistance is not as good as the straight aluminum coating. Up to about 750 F, the aluminum-zinc system is satisfactory, but

Fig 1 *(Left) Effect of acetone 10 sec after being poured on untreated and modified high molecular weight cellulose acetate butyrate films. A dye was incorporated in the acetone as an indicator. Film on left is untreated, film on right contains 10% tetraisopropyl titanate. (Right) Same film after 40 min. The titanated film has swelled slightly but has not dissolved.*

Eastman Chemical Products, Inc.



above this point the zinc oxidizes rapidly and causes film failure.

Zinc dust butyl titanate paint on steel also provides extremely good protection against atmospheric and salt water corrosion. In a humidity test conducted at 108 to 118 F and 100% relative humidity, no corrosion was observed over a period of many weeks. Using ASTM salt spray test B117-49T (20% salt solution, 95 F) no corrosion occurred after 30 days. In contrast, conventional primers tested at the same time permitted varying degrees of corrosion, many of them after relatively short time periods.

Steel panels coated with zinc dust butyl titanate paint and exposed just above normal high tide levels have shown corrosion resistance better than panels coated with red lead primer and an aluminum spar varnish finishing coat. Test panels immersed in the sea have exhibited practically no corrosion after two years, and some panels coated with the zinc dust paint as primer and with aluminum finishing coats also showed no corrosion after 18 months immersion. After immersion zinc dust paint films are also much harder than conventional coatings, so hard in fact that they are difficult to remove even by sand blasting.

Protection from marine fouling

The zinc dust butyl titanate coating also possesses excellent anti-fouling properties. The toxicity of zinc compounds toward fouling of marine organisms such as weeds and barnacles is well known, but when used in organic coatings zinc is not usually sufficiently toxic to provide good protection. The completely inorganic layer deposited with the zinc dust butyl titanate coating, produces an inherently porous film with a large surface area that is conducive to the dissolution of the toxicant. Consequently, a high concentration is obtained in the area immediate to the paint film.

Various experimental formulations using the common toxic pigments have demonstrated the superior anti-fouling properties of butyl titanate paints containing equal parts of zinc dust and copper oxide. This coating has successfully resisted marine fouling for periods up to nine months and possesses better hardness and adhesion characteristics than other coatings tested.

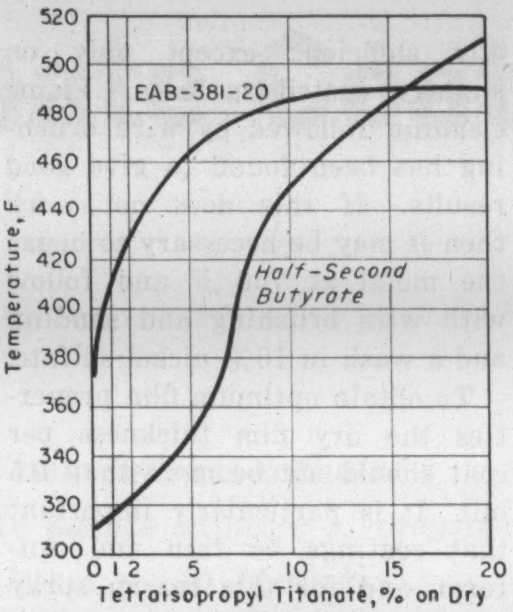


Fig 2 *Effect of concentration of tetraisopropyl titanate on the heat resistance of cellulose acetate butyrate.*

Butyrate coatings

Another significant application of titanium esters is their use in the modification of cellulose acetate butyrate lacquer coatings for improved heat and solvent resistance. The excellent adhesion and hardness of this recently developed lacquer and its resistance to weathering and abrasion has led to its use in a wide variety of applications as a protective coating for metals, paper, wood, plastics, cloth and leather. Wider applications in many cases have been prevented because of limited resistance to heat and solvents. By adding tetraisobutyl titanate to the cellulose acetate butyrate solution, it has been found that these properties can be substantially improved.

In two-package systems, where indefinite solution stability is required, the titanate solution is added to the lacquer solution just prior to application. This may be performed as a thinning operation in which the amount of titanate solution added is adjusted to suit the viscosity of the final system.

A demonstration of the superior resistance of the butyrate-titanate film to solvents is shown in Fig 1. Ordinarily, acetone is one of the most active solvents for cellulose acetate butyrate but with the addition of a sufficient amount of the titanate to the butyrate, films exhibit a high degree of resistance to this solvent as well as to other lacquer solvents such as methyl isobutyl ketone and methylethyl ketone.

Cellulose acetate butyrate films containing over 3% tetraisobutyl titanate are insoluble in acetone and similar solvents. Some degree of swelling occurs on contact with a few solvents and the degree of swelling or resistance to solvents is proportional to the amount of titanate present. Solvents such as ethyl acetate, a blend of 80 toluene 20 ethanol and certain other blends are capable of dissolving titanated butyrate films if sufficient contact time is allowed.

The increase in heat resistance imparted to cellulose acetate butyrate with increased concentrations of titanate is indicated in Fig 2. Points on the curve represent temperatures at which heat flow occurred in film specimens loaded at 25 psi. Actual film melting points are of course higher than the temperature given.

Acknowledgment

The assistance of the following organizations in the preparation of this article is gratefully acknowledged:

Defence Research Laboratories, Commonwealth of Australia

Eastman Chemical Products, Inc.

E. I. du Pont de Nemours & Co., Inc.

Peter Spence & Sons Ltd.

Titanium Pigment Corp.

References

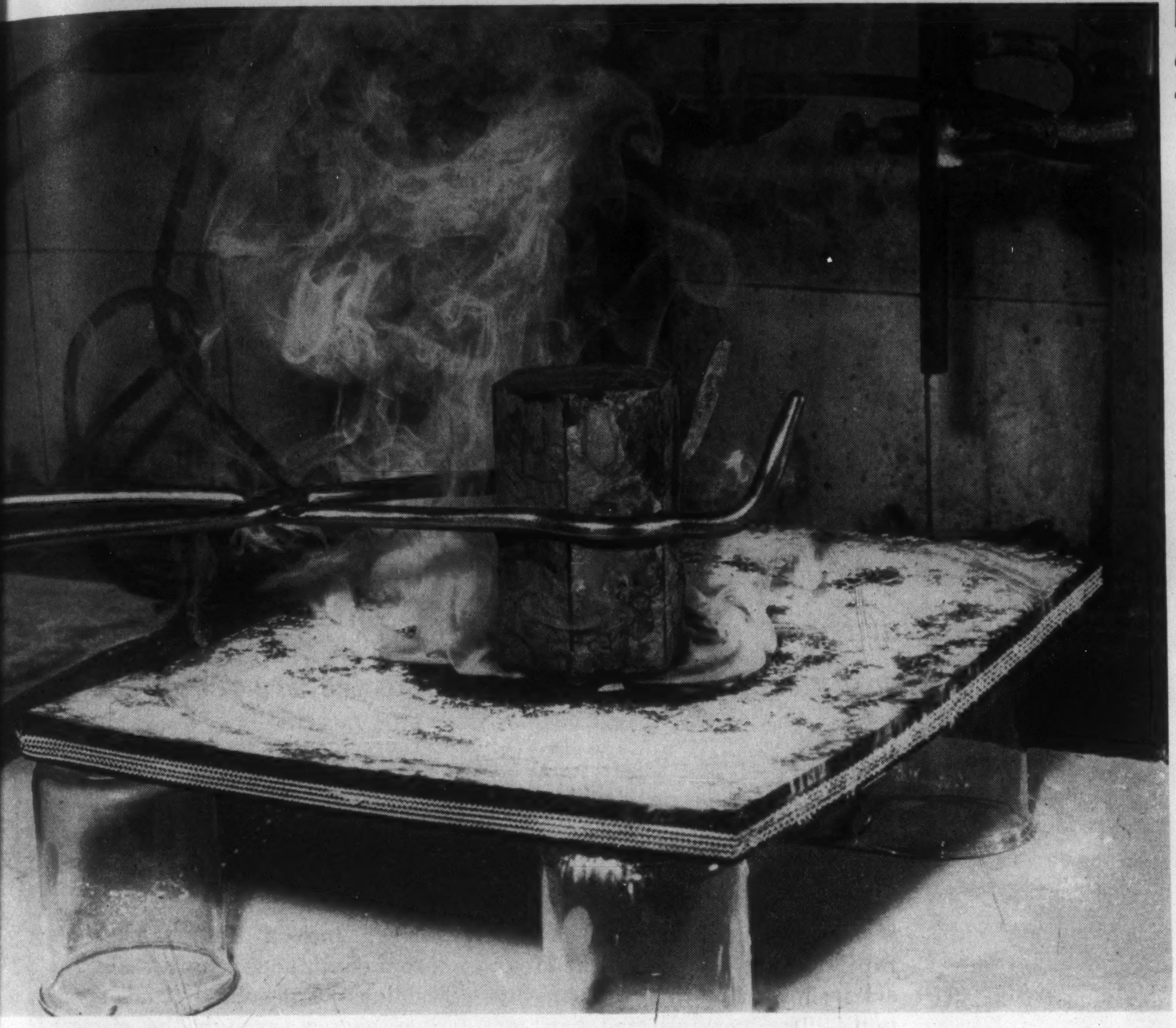
Harold C. Brill, "Recent Developments in Titanium Research," *Tappi*, vol 38, May 1955, p 141A-146A.

A. B. Cox and G. Winter, "Butyl Titanate Heat and Corrosion Resistant Paints," *Paint Manufacture*, Apr 1955, p 146-150.

George W. Grupp, "Butyl Titanate Heat and Corrosion Resistant Paints," *Organic Finishing*, Sep 1954, p 15-16.

R. Sidlow, "Alkyd Titanates: Their Preparation and Applications," *Chemical Products*, June 1953.

G. Winter, "Esters of Titanium and Their Use in Paint," *Journal of the Oil & Colour Chemists' Association*, vol 36, Dec 1953, p 701-708.

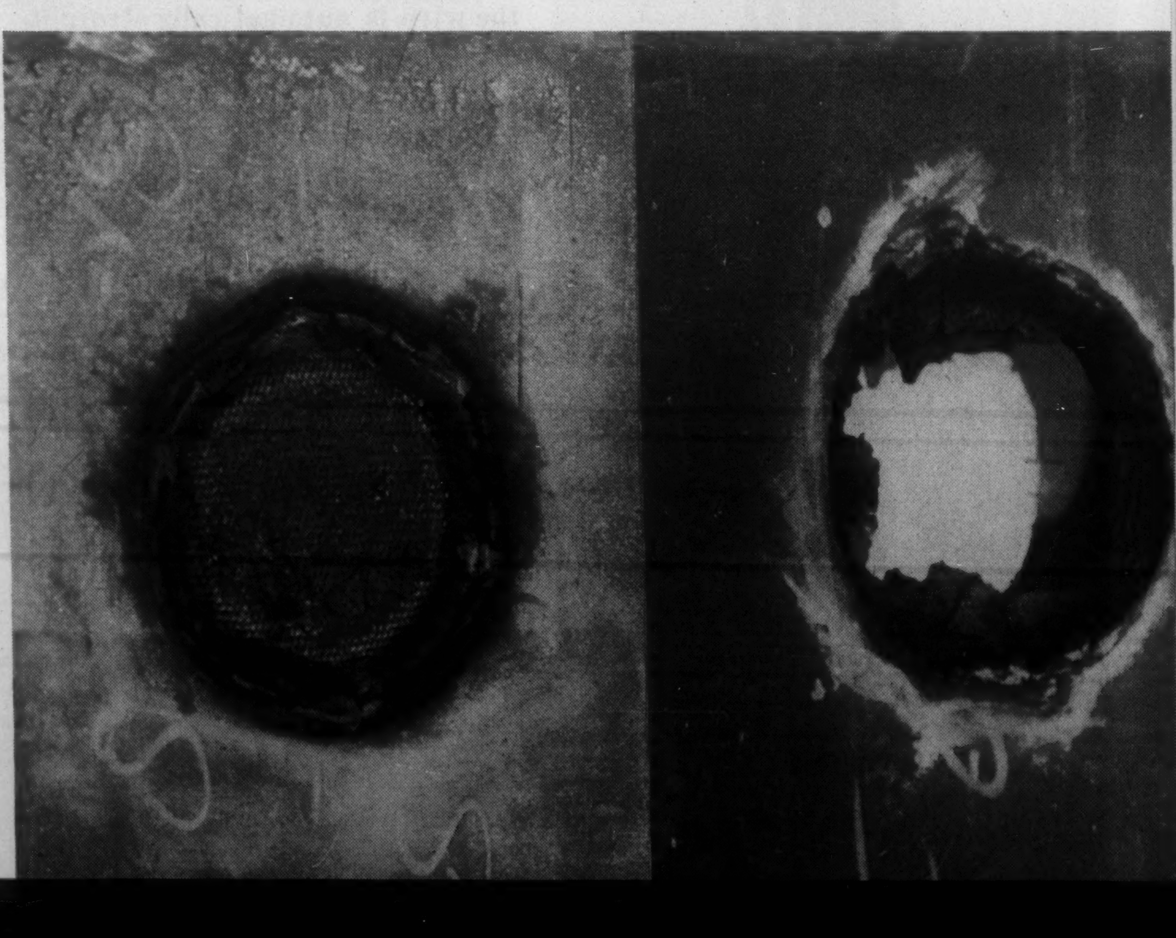


Glass fabric conveyor belt resists 1400 F

Hot metal, heated to 1400 F, is shown testing the hot material rubber conveyor belt, developed by B. F. Goodrich Co. Called Fire Curtain, the belt has two plies of glass fabric that "float" in the top rubber cover.

The hexagonal steel bar was heated to 1400 F and placed on the sample belt for 20 min. It was then removed, reheated to 1400 F and returned to the same spot on the belt for another 20 min.

Below left is the sample of Fire Curtain after test. Belt's top rubber cover is charred, revealing glass fabric heat barrier that prevented the hot metal from passing through the belt. At right is a conventional hot material belt sample after 3 min of the second 20-min test.



Equipment and products for:
marine service,
materials handling,
chemical and processing fields,
architectural applications, use . . .

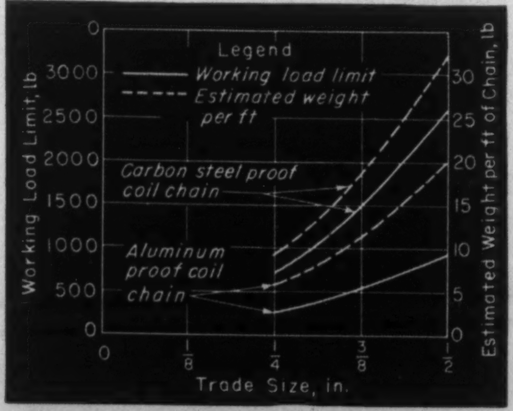
Aluminum Chain

where qualities of light weight, non-sparking, nonmagnetic, and corrosion resistance are required.

by H. F. Reid, Jr. *Manager, Technical Service Div., The McKay Co.*

■ Welded aluminum chain is currently being made in the four sizes shown in the accompanying table. The working load limit of the chain is approximately 60% of the same size steel proof coil chain. This 40% reduction in rated capacity, however, is offset by a more than 65% reduction in weight.

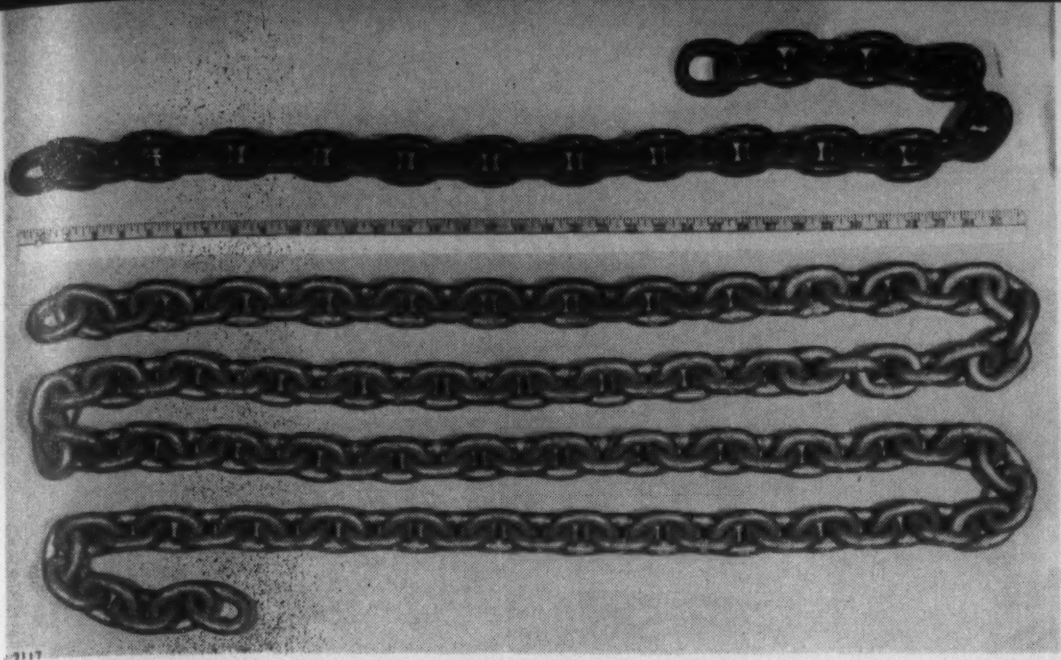
In the electric welding manufacture of aluminum chain, coils of wire or rods pass through a chain forming machine in which the wire is automatically straightened, cut to required lengths, formed into a link, then made into a continuous length ready for welding. The side-butted chain then passes through the electric welding machine where it is welded automatically. The resultant flash on each link is trimmed leaving a relatively smooth weld.



Aluminum chain size *can be increased for greater strength and still affect a substantial weight savings as compared to steel chain.*

The main production problem was the modification of standard chainmaking equipment to produce uniform aluminum welds. The aim was to produce a link which would fail at the end of the link rather than in the vicinity of the welded joint.

In recent months, weldless aluminum chain has also become available. In making weldless chain, light gage aluminum wire is automatically cut to lengths and then knotted or twisted together to form a continuous length of chain. In heavier wire sizes, nonwelded chain, where the ends of each link are merely butted together, has found use in some applications. Cast aluminum chain, by nature of the manufacturing operation has been limited to the larger sizes of chain.

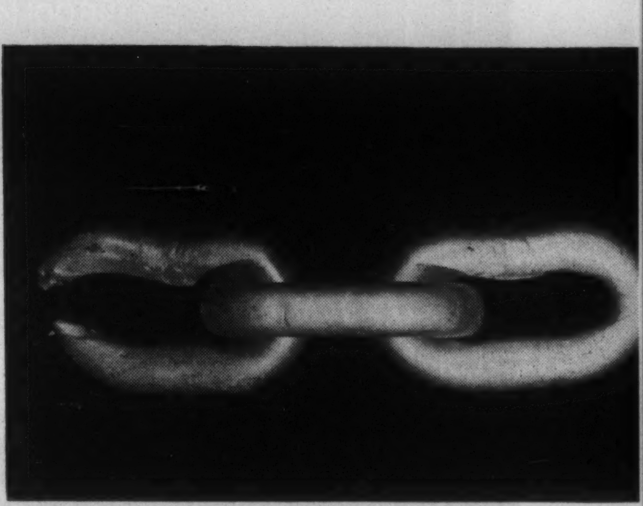


Length-to-weight ratios *of welded aluminum chain compared to welded steel chain. Ten pounds of ½ in. steel chain is 48 in. long; by contrast the same size and weight in aluminum chain is 152 in. long.*

After proof testing, *the aluminum chain is inspected link by link.*

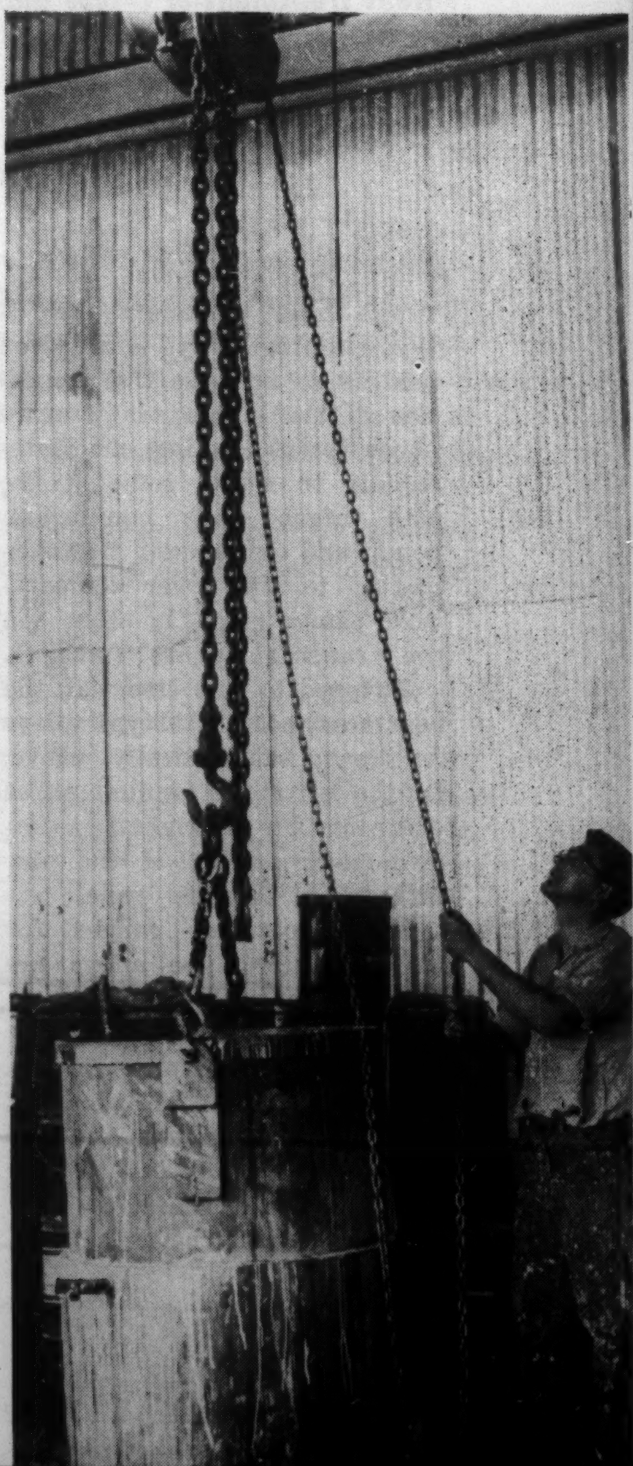
SPECIFICATIONS FOR WELDED ALUMINUM CHAIN

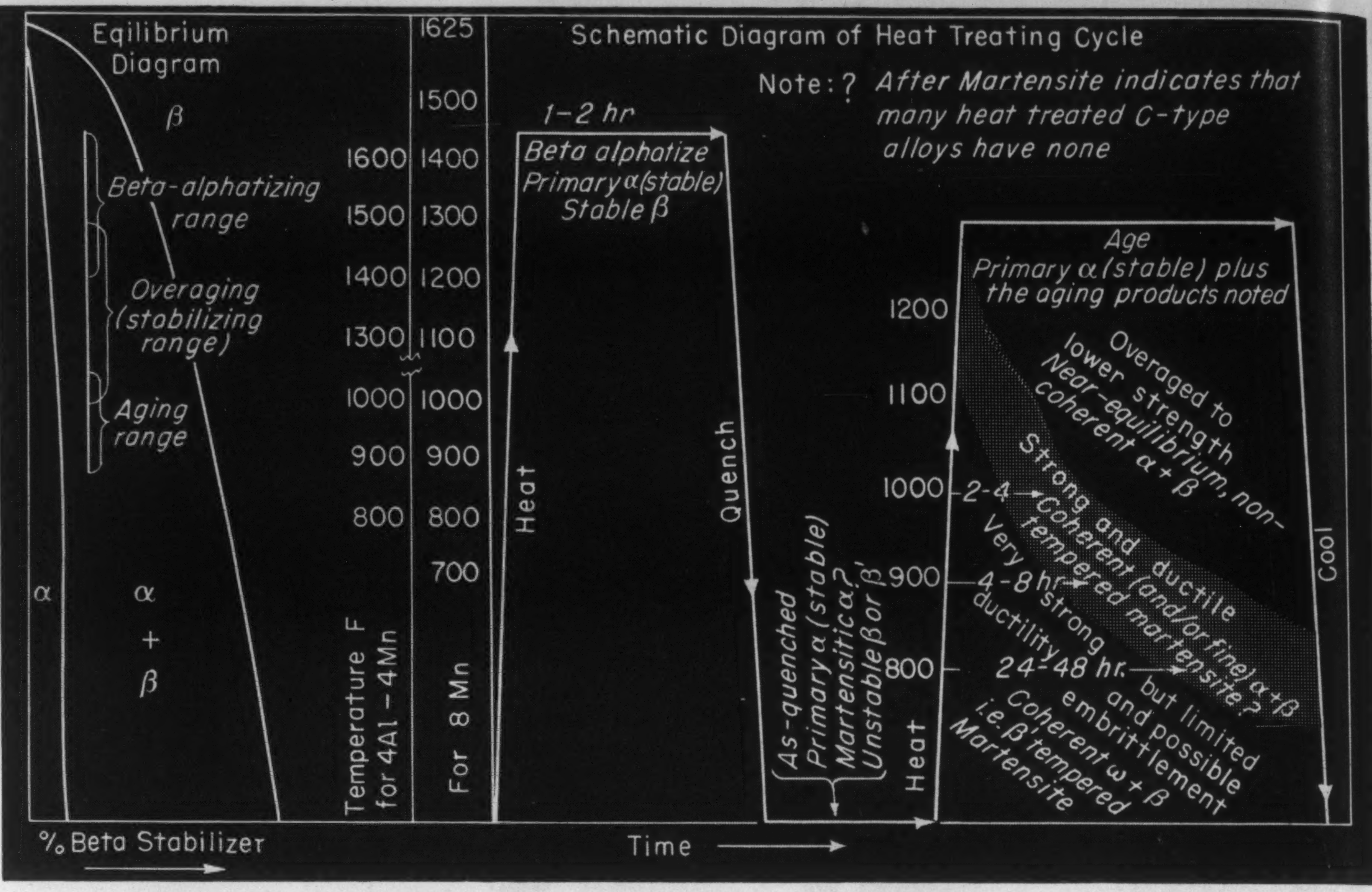
Chain Size, in.	Material Diameter, in.	Inside Link Size		Working Load Limit, lb	Weight per 100 ft, lb
		Width, in.	Length, in.		
¼	9/32	½	1	550	24
5/16	11/32	½	1 7/64	850	36
⅜	13/32	⅝	1 15/64	1200	54
½	17/32	13/16	1½	2000	91



Welded aluminum chain *tested to destruction. Link failed at a point other than the weld joint.*

Aluminum chain assemblies *are particularly suitable in industries where corrosion resistant, nonsparking, nonmagnetic properties are required.*




Eqilibrium Diagram
β
Beta-alphatizing range
Overaging (stabilizing range)
Aging range
α
α + β
% Beta Stabilizer
Temperature F for 4Al – 4Mn
For 8 Mn
1625
1500
1600 1400
1500 1300
1400 1200
1300 1100
1000 1000
900 900
800 800
700
Schematic Diagram of Heat Treating Cycle
Note: ? After Martensite indicates that many heat treated C-type alloys have none
1–2 hr
Beta alphatize Primary α (stable) Stable β
Heat
Quench
As-quenched Primary α (stable) Martensitic α? Unstable β or β'
Heat
1200
1100
1000
900
800
Age Primary α (stable) plus the aging products noted
Overaged to lower strength Near-equilibrium, non-coherent α + β
2-4
Strong and ductile Coherent (and/or fine) α + β tempered martensite?
4-8 hr
Very strong but limited ductility and possible embrittlement
24-48 hr.
Coherent ω + β i.e. β' tempered Martensite
Cool
Time

Heat treatment *of C-type titanium alloys.*

Principles of Heat Treating Titanium

The heat treatability of *C*-type titanium alloys is based on heating to increase the proportion of the higher temperature phase (beta), cooling sufficiently rapidly to retain some of the beta beyond the equilibrium point, and subsequent transformation to the lower temperature phase (alpha), often via the transition phase (omega).

Stripped to this essential, the heat treatment of *C*-type alloys is shown schematically above. On the left is the familiar phase diagram. On the right is a diagrammatic outline of the preferred heat treating cycle.

Heat treatment ranges for two typical C-type alloys are shown, one with only a beta stabilizer (8 Mn) and the other with both an alpha and a beta stabilizer (4Al-4Mn). Heat treating temperatures for the latter are about 200 F higher than for the 8 Mn alloy with the exception of the aging temperatures which are similar for all *C*-type alloys.

To develop beta which will become unstable upon quenching and so permit strengthening, the alloy is heated to the *beta-alphatizing range*. In general, it is important that, unlike steel and aluminum alloys, one does **not** heat *C*-type titanium alloys into the single phase high temperature field (beta). Heating to 100-300 F below the all-beta region results in much better strength - ductility combinations in the subsequent aged condition. Heating to the all-beta region promotes a coarser beta grain size and initial transformation occurs at the beta grain boundaries. Both factors appear to be detrimental to ductility.

At the beta-alphatizing temperature the structure consists of a small amount of stable residual primary alpha and a larger amount of stable beta. It is then quenched to develop some unstable beta and aged at a moderately elevated temperature to partially transform the beta to fine alpha. This gives a strong ductile material.

A second mechanism of titanium transformation hardening which is showing promise is analogous to the martensitic hardening in steel. The difference, and it is important, is that the supersaturation of the low temperature phase may be small in the titanium alloys compared with that in steel.

When a martensitic-quenching *C*-type alloy like 6Al-4V is beta-alphatized, e.g. at 1550 F, the beta is enriched as shown by the equilibrium diagram and no martensite is formed on quenching. In this case heat treatment response is entirely by the unstable beta mechanism previously outlined. As indicated, combinations of unstable beta and of martensitic hardening are also possible.

This chart shows

How to Heat Treat Titanium

Development of suitable heat treatment procedures opens the way for increased use of titanium alloys in applications where high strength-weight ratios are required.

by Walter L. Finlay, W. W. Wentz and D. W. Kaufmann

Rem-Cru Titanium, Inc.

■ Titanium is a promising structural metal, because it is light, strong, corrosion resistant and ductile. It fills the gap between aluminum and stainless steels with respect to modulus, density and elevated temperature strength. Where titanium replaces stainless steels section for section, a 40% reduction in weight is obtained.

This weight reduction gained by using titanium has focused attention on heat treating titanium alloys to obtain the increased strength needed for many structural parts, particularly in aircraft construction.

Extensive research has shown that a significant strength increase can be realized by quench-age heat treatment cycles. This development opens the way to take advantage of the higher strength-weight ratio of heat treated titanium.

Practical heat treatment

Principles of the heat treatment of titanium alloys are discussed in an adjacent box. The commercially available heat treatable titanium alloys are all *C*-type alloys and heat treatment involves quenching from a suitable solution temperature and aging at some lower temperature.

In selecting the solution temperature, one should quench from the lowest possible temperature which will create sufficient unstable beta to allow overaging to the desired strength level.

Effect of cooling rate—Cooling rate from the solution temperature has an effect on the aging response of alpha-beta alloys. This has been demonstrated by tension tests on specimens heated to appropriate solution temperatures cooled by water quenching, oil quenching, or air cooling to room temperature and aged for various times at 900 F.

The results indicate that:

1. Cooling rate from solution temperature has little effect on the quenched-aged ductility.
2. Maximum available strength on aging at a given temperature increases with increasing cooling rates. That is, the maximum strength obtained by water quenching and aging at 900 F is greater than that obtained on oil quenching and aging at 900 F. Oil quenching in turn results in a greater maximum strength than air cooling.
3. For a given solution and aging treatment, the faster cooling rate also results in the greater strength level.

An accompanying table indicates that the best strength-ductility combinations for the aged condition are obtained by a water quench from the solution temperature although very respectable properties are obtained with slower cooling rates. Possibly, strength-ductility combinations for the slower cooling rates may be increased by an appropriate change in the aging cycle.

Aging—The aging cycle should be chosen to: 1) Assure aging for sufficient time to transform the embrittling omega phase, and 2) avoid excessive scaling to reduce the need for a final cleaning operation on the heat treated part.

A general rule governing the selection of an aging cycle is: Age at the lowest possible temperature above the expected service temperature, but not under 800 F, for a sufficiently long time to allow over-aging with a minimum amount of scale formation. At 800 F this requires at least 24 hr. The time can be reduced by increasing the aging temperature. Aging at temperatures of 900 to 1000 F requires 4 to 12 hr and this is the preferred temperature range.

The wide variety of possible heat treatment cycles makes possible an equally wide range of

EFFECT OF COOLING RATE FROM BETA-ALPHATIZING TREATMENT

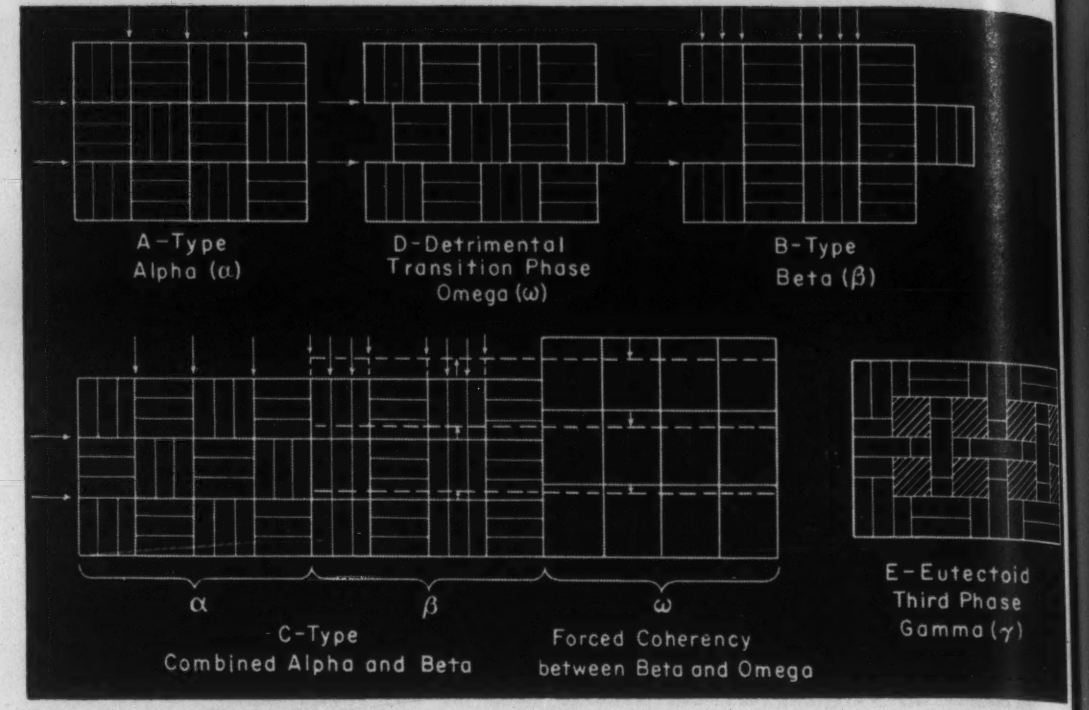
Alloy	Condition	Tens str, 1000 psi	Yld str, 0.2% 1000 psi	Elong, % 2 in.	Red. of area, %
C130AM	Annealed	159	—	18.7	48.6
	2 hr, 1450 F, w.q.; 8 hr, 900 F	185	172	13.0	37.7
	2 hr, 1450 F, o.q.; 8 hr, 900 F	173	159	11.0	26.7
	2 hr, 1450 F, a.c.; 8 hr, 900 F	163	154	14.0	32.5
C120AV	Annealed	156	—	15.0	49.5
	2 hr, 1600 F, w.q.; 8 hr, 900 F	196	173	10.0	38.0
	2 hr, 1600 F, o.q.; 8 hr, 900 F	192	170	11.0	40.5
	2 hr, 1600 F, a.c.; 8 hr, 900 F	156	146	15.0	51.0

Note: w.q.—water quenched
o.q. —oil quenched
a.c. —air cooled

ABCDE'S of Titanium Structure

The structure of titanium can be readily understood by likening the ordered array of atoms in a crystalline lattice to the similarly ordered array of bricks in a wall. While the metallurgist uses the term "hexagonal-close-packed lattice" to describe a particular pattern of objects (like titanium atoms for instance) the bricklayer uses the term "alternate sides and ends" to describe one way to lay a row of bricks. Likewise the metallurgist uses the term "phase" to mean a particular pattern of arranging atoms. He identifies these atom patterns with Greek letters rather than with English letters as we will do here.

In the following paragraphs, one brick takes the place of one atom in the titanium lattice.



Note: Arrows indicate slip planes.

Schematic diagram *of titanium phases using bricks as atoms.*

Types of titanium structures

There are three basic types of titanium-rich structures in commercial titanium alloys:

A. Pure titanium always forms the A-type of atomic arrangement when the temperature is below yellow heat. This arrangement is called alpha (α) and is hexagonal-close-packed. For our purpose it is more convenient to visualize α as the A brick arrangement shown in the figure than as hexagonally-close-packed spheres normally used by the metallurgist. In this visualization, no mortar holds the bricks together. In fact they may best be thought of as smooth iron magnets strongly attracted to and sliding on each other with a thin oil film between. Arrows indicate the planes on which slip can occur. The more planes the better the formability. The A-type arrangement of bricks has five slip planes. The B-type has nine slip planes and beta titanium has better formability than alpha titanium of the same strength level.

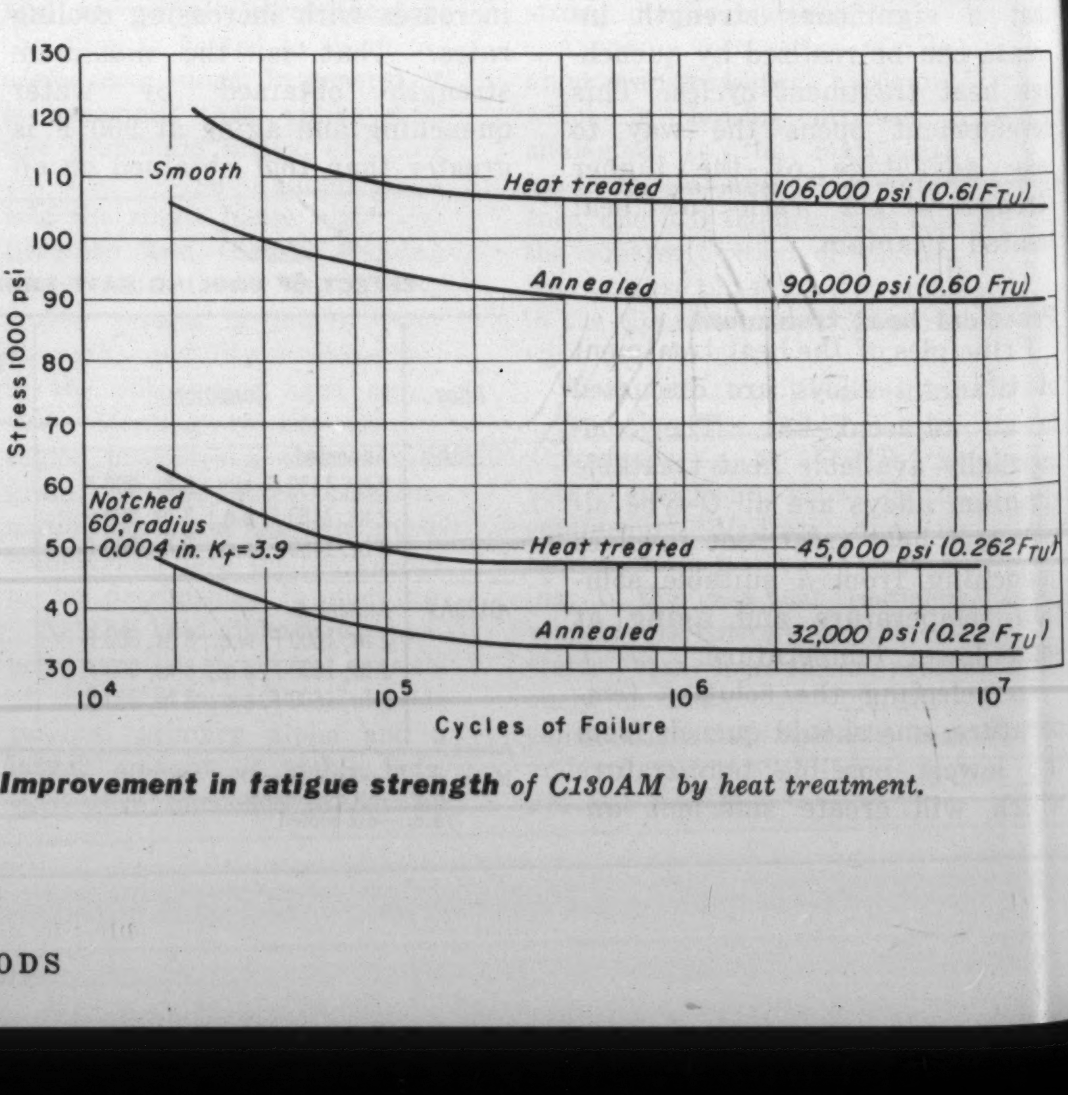
B. When heated above a yellow heat, titanium changes from the A type arrangement to the B-type or beta (β) arrangement. Beta titanium has a body-centered-cubic structure. Referring to the brick analogy, A-type changes to B-type by shifting the middle row one square to the right.

---

tensile properties. In general, results to date show that strengths in the range of 150,000 to 200,000 psi with elongation from 8 to 15% are obtainable.

There are numerous complexities and several practical considerations involved in this essentially simple picture of quench-aging. Titanium's affinity for oxygen, nitrogen and water vapor and their deleterious effects on properties are well known. Heating times should be kept at a minimum and furnace atmospheres should be neutral or, preferably, slightly oxidizing and free of moisture to minimize hydrogen contamination. Electric resistance type furnaces are quite satisfactory in these respects. If gas or oil-fired furnaces are used, the flame should not be allowed to impinge upon the material.

Hardenability — Cooling rates are an important consideration in heat treatment operations, and are strongly influenced by section-size. The interrelation of cooling rate and section-size and their combined influence on heat treatment response falls into the general category of hardenability.



Improvement in fatigue strength *of C130AM by heat treatment.*

Similar shifts of planes of atoms occur in actual metals—in their most prominent manifestation (the martensite reaction) they can be heard as a sharp click with a sensitive phonograph pickup and they bulge a flat polished surface just as the middle row of bricks bulged the right side of the beta-type pattern.

C. By alternating **A** pattern and **B** pattern, a **C** (combined **A** and **B**) pattern is obtained with strength and ductility combining those of **A** and **B**.

Quenching a C-type from an elevated temperature (e.g. above 1300 F) prevents transformation of all the **B** formed at the elevated temperature back to **A**. This is the beginning of titanium's heat treatment response. If warmed, as in aging, this unstable **B** starts to transform back to **A**. This transformation is visualized in the figure as a two-step process. The first step takes the transformation part way, forming omega.

D. Omega is often but not always associated with low ductility. This is symbolized by omega having only two slip planes compared to **A** with five and **B** with nine. The missing slip planes were lost when transformation stopped between **B** and **A**. Hence, omega is called a transition (between **B** and **A**) phase. At this point the material is strongest and least ductile.

E. A considerable number of titanium alloy systems are eutectoid like steel. Instead of iron carbide precipitating, these titanium alloys precipitate analogous eutectoid compounds like $TiCr_2$. Such compounds are brittle and this is symbolized by the absence of any slip planes in the **E** (eutectoid compound) pattern.

Thus, we have the A B C D E's of titanium heat treating: we start with **A** and **B** titanium; combining them gives us **C**; partially transforming **B** to **A** produces **D**; and, in eutectoid systems, some **B** may transform to **E** as well as to **A**.

Coherent and incoherent

The strengthening effect of omega is largely due to the fact that it is coherent with **B**. This term may render some non-metallurgists incoherent with annoyance but the idea of a coherent transition lattice is very useful since it is the basis for the major mechanism of age hardening. The most famous coherent transition lattice is probably that of the duralumins (Al-Cu alloys) called theta-prime. A good many tons of theta-prime duralumin have satisfactorily flown in aircraft for several decades and this helps make an important point: there is nothing basically mysterious about omega; it is the same sort of thing that has been found in many other alloys and its causes and the means for controlling it are well known.

To date, the best combinations of strength and ductility in titanium alloys are obtained just after omega has been removed by overaging. Coherency and overaging to non-coherency are explained in the next two paragraphs.

The schematic representation of both coherency and non-coherency between the **B** matrix and the omega which formed from it are shown above. Solid lines show the **B** non-coherent (i.e. the atom planes do not line up) with the omega, after overaging. During overaging, the coherent omega (shown by dashed lines which line up with the dashed lines of **B**) grows large enough to assert its own individuality by breaking away from coherency with beta and establishing its normal atom plane spacings (solid lines).

These expanded (and contracted) slip plane spacings can be considered as not matching those of the remainder of the structure. Slip therefore is inhibited, i.e. the structure has been coherency strengthened. As previously mentioned, this is probably the major source of age hardening.

In general there are no sharp discontinuities in strength and ductility as omega disappears. Rather there is a blending of low ductility region in which omega is present with a higher ductility region in which omega is not present.

Relatively little work on the hardenability characteristics of the commercial titanium alloys has been done to date. The indications are, however, that hardenability, as might be expected, varies rather markedly with composition. In general, it appears that increasing beta stabilizer (Mn, V, Mo, Fe, etc.) content results in increasing hardenability. Increasing alpha stabilizer content, on the other hand, decreases the hardenability of alpha-beta alloys.

Some of the preliminary hardenability data gathered to date are summarized in a table. Results were obtained by end-quenching from the indicated temperature and subsequent aging. This table does not imply that the conditions noted are optimum for each alloy. There is evidence, however, that C130AM hardens uniformly. Results obtained on a step-down quench bar machined from C130AM and subsequently heat treated are shown graphically. Apparently, the cooling rate, on quenching, through the center of a 1½ in. dia. bar is not sufficiently different from that in a ¼ in. dia bar to cause any significant difference in the aged strength level. The elongation, on the other hand, decreases with increasing section size beyond ¾ in. dia although the minimum elongation is in excess of 10%. The trend of the elongation curve

TYPICAL STRENGTH IMPROVEMENT BY HEAT TREATMENT OF BAR STOCK

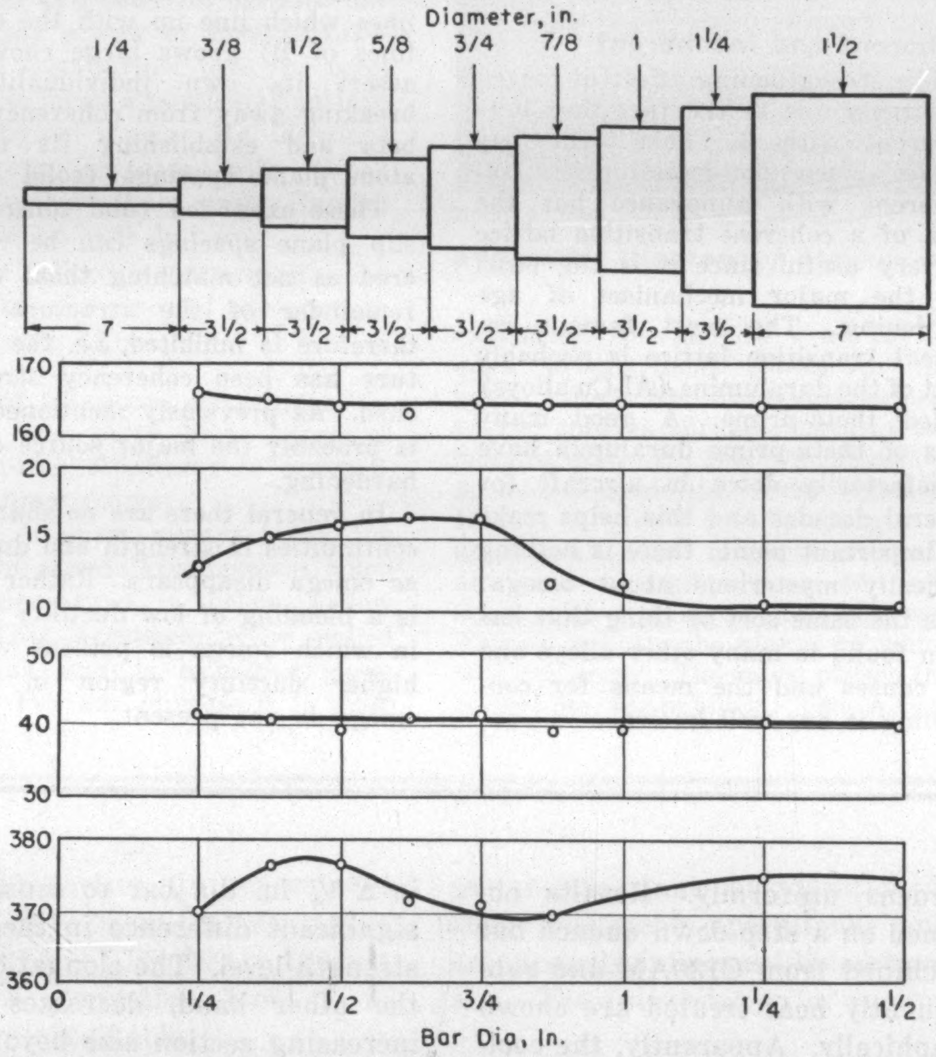
Alloy	Condition	Tens Str, 1000 psi	Yld Str, (0.2%) 1000 psi	Elong % 2 in.	Red. of area, %
C130AM (4Al-4Mn)	Annealed	156	149	17.5	40.5
	2 hr, 1450 F, w.q.; 8 hr, 900 F	177	160	13.4	28.5
C140AM (6Al-4Mn)	Annealed	157	155	19.0	49.5
	2 hr, 1600 F, w.q.; 8 hr, 900 F	196	171	9.0	26.4
C120AV (6Al-4V)	Annealed	152	146	14.4	39.9
	2 hr, 1500 F, w.q.; 8 hr, 900 F	166	154	14.5	42.0

Note: w.q.—water quenched.

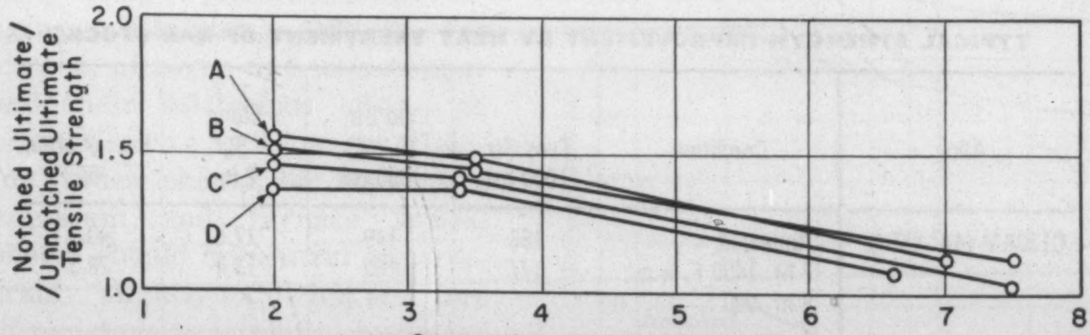
HARDENABILITY DATA

Alloy	Sol Temp, F	Aging Cycle		Tensile Strength, 1000 psi and Vickers Hardness No. (in parentheses) at:				
		Hr	F	3/16 in.	9/16 in.	1 in.	2 in.	3 in.
C130AM	1450	8	900	199 (411)	198 (410)	196 (408)	190 (407)	187 (404)
C130AM	1450	16	900	182 (399)	181 (403)	181 (399)	187 (400)	183 (414)
C120AV	1600	8	900	165 (335)	154 (326)	152 (324)	146 (305)	149 (313)
C140AM	1600	16	900	199 (416)	186 (415)	178 (401)	171 (394)	171 (396)
C140AMo[a]	1600	16	900	181 (364)	174 (367)	170 (360)	166 (348)	169 (352)

[a] 6Al-4Mo



Effect of section size *on heat treatment response of C130AM. (Heat treatment 2 hr at 1450 F, water quench, 8 hr at 900 F.)*



Effect of notches *on the ratio of the notched/unnotched tensile strength of C130AM.*

Curve	*Unnotched ult tens str-psi*
A	*165,100*
B	*166,700*
C	*166,800*
D	*177,400*

indicates that the material beyond ¾ in. is not completely overaged. This phenomenon is attributed to the rate of cooling since previous work has shown that decreasing cooling rates result in an increasingly sluggish aging response. Continued aging will correct the situation and result in a more uniform elongation.

Work to date indicates that C130AM is relatively deep hardening. Although little work has been done on C120AV, C140AM, and C140AMo it does not appear that they have the deep hardening characteristics exhibited by C130AM. This is true particularly of C120AV.

Annealing—Titanium, like other metals, may be heat treated advantageously for one of several reasons: 1) stress relief anneal to relieve internal stresses set up by cold work; 2) stabilize or full anneal for maximum ductility and stability; and 3) thermal hardening to increase strength. Although this discussion is concerned primarily with hardening, its principles apply to annealing as well.

For example the quench shown in the diagram might be the air cooling of a forging rather than a deliberate heat treating operation. Its subsequent heat treatment should therefore follow the same principles as those used for deliberately quenched material.

Applied particularly to annealing, these are:

1. Cooling from the solution temperature range develops some unstable beta if the cooling rate is fast enough for the particular composition.
2. For maximum stability and ductility, such material should be overaged.
3. The advantage of overaging can be partly lost by too rapid cooling from the overaging temperature since this can develop its own unstable beta. Again the minimum temperature and cooling rate depend upon composition but the safe practice for the maximum stability and ductility is to furnace cool at a rate not exceeding 5 F per min to about 1050 F

and air cool thereafter.

4. For maximum ductility, overage for long periods, e.g. 24 hr.
5. For maximum stability, cool as slowly as possible to the expected service temperature.
6. Stress relieving can be done at the lower end of the overaging range.

Effect on mechanical properties

Although effect of cooling rate and hardenability considerations are extremely important, the main objective of heat treatment is mechanical property enhancement.

Tensile properties — Statistical data on the room temperature tensile properties of C130AM and C120AV have been collected and the results given in a table indicate the average improvement in strength which results from heat treatment of these alloys. Preliminary results are reported also for C140AM.

With the quenching and aging treatments listed, C130AM increased in tensile strength from 156,000 to 177,000 psi, C140AM from 157,000 to 196,000 psi and C120AV from 150,000 to 166,000 psi. Yield strengths showed a corresponding increase. Ductility as measured by elongation was practically unchanged in C120AV, slightly lowered in C130AM and reduced roughly 50% in C140AM.

Shear properties—A recent statistical survey of the room temperature shear strength of annealed C130AM bar stock shows an average shear strength of 107,400 psi. The shear strength of C130AM may be substantially altered by heat treatment. Shear strengths of 110,000 to 115,000 psi can be expected by heat treating for two hours at 1450 F, water quenching, and aging 8 hr at 900 F.

Fatigue properties—Evaluation of the fatigue properties of heat treated C130AM is still in progress. Results to date show an endurance limit (10^7 cycles), in smooth rotating beam fatigue tests, of 105,000 psi at room temperature on the heat treated material. Annealed C130AM tested under the same conditions has an endurance limit of 90,000 psi. Even more encouraging however, is the available notched rotating beam fatigue data. At a stress concentration of 3.9 the endurance limit for the heat treated alloy is 40-45,000 psi. Under the same conditions, annealed C130-AM has an endurance limit of 30,000 psi. Apparently heat treatment does not adversely affect the notch sensitivity of the material in rotating beam fatigue tests.

Notched properties—The effect of cut notches on the tensile properties of heat treated material is summarized in a graph. Assuming a material to be notch sensitive if the notched ultimate to unnotched ultimate ratio falls below unity, C130AM heat treated (quenched and aged) to 177,400 psi ultimate strength, is not notch sensitive in tension at a stress concentration up to 6.5. Evidence has been observed indicating that quenched and aged C130AM is also notch insensitive in rotating beam fatigue tests.

MATERIALS AT WORK

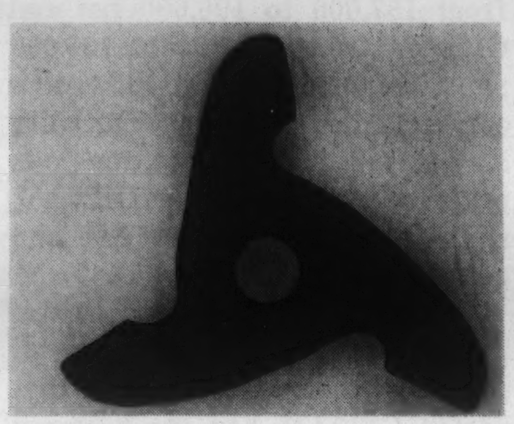
DANGER
15,000 VOLTS
DANGER
15,000 VOLTS

Expanded metal cable trough saves space

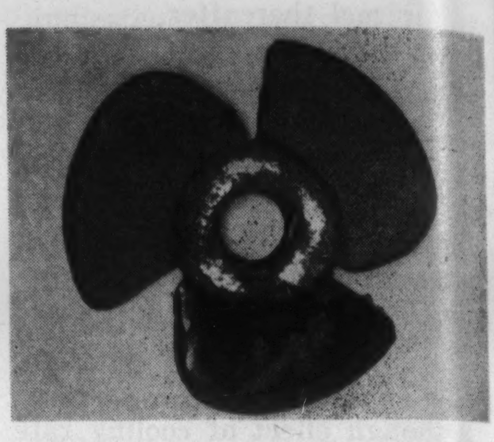
This expanded metal cable trough installation in a Scott Paper Co. plant was prefabricated by T. J. Cope, Inc. It is made from expanded steel No. 9 gage, ¾ in. diamonds, rolled and flattened to No. 11 gage to eliminate rough edges. Edge of trough is 3 in. high protected by steel strip on top. The entire assembly is then hot dip galvanized for corrosion resistance.

The cable trough is reported to be as flexible as conduit, easier to install and has greater current carrying capacity. Other advantages over conduit include savings in material and better use of ceiling and wall space. Cables are accessible at any point.

Impeller *produced by hot pressing a mixture of 85 ferroboron-15% iron powder.*



Impeller *formed by shaping a cold pressed green compact and sintering after shaping.*



Screw propeller *made by shaping a green compact produced by cold pressing a mixture of 85 chromium boride-15% iron powder and sintering after shaping. One blade ground after sintering.*

Boride Parts Resist Molten Zinc

Compacts composed of a boron compound plus a metal are heat and corrosion resistant and compare favorably in strength with graphite and gray iron.

by R. M. Evans, *Battelle Memorial Institute*

■ Application of powder metallurgy methods to the production of boride parts has resulted in the development of products that not only resist oxidation up to 2350 F (M&M, Aug, 1954), but also are unattacked by molten zinc, a metal that is highly corrosive toward common structural materials.

Parts are formed by sintering a compact containing a mixture of a boron compound and a metal such as iron, cobalt or nickel. During sintering, boron from the compound diffuses into the metal to produce a strong, heat and corrosion resistant material.

Raw materials for the production of these zinc resistant products are common commercial materials and the compounds formed from them are iron boride, chromium boride and manganese boride. Pump parts, zinc die casting machine components and other parts for service in contact with molten zinc can be produced readily from these borides.

Properties of compacts

In the development of these borides, compacts were prepared by cold or hot pressing.

For cold pressing, powders were mixed with a small amount of an organic binder to promote green strength. Compacts were cold pressed in steel dies at 11,000 psi. After pressing, the green compacts were dried in air at 300 F to remove the binder.

Before sintering, melting points of the various mixtures were determined as a guide in selecting sintering temperatures. Normally, the proper sintering temperature for powdered metal compacts ranges from half the melting point to about 90 to 130 F below the melting point. Rapid sintering at the higher temperatures proved most satisfactory because slow sintering at lower temperatures permitted the formation of non-zinc-resistant boride phases.

Successful presintering and sintering operations were performed in a hydrogen atmosphere muffle furnace. Induction heating was not efficient on mixtures containing chromium or manganese borides. During sintering all cold pressed bodies underwent a volume shrinkage of about 36%.

Typical properties of cold pressed and sintered bodies of uniform cross-section are shown. These data indicate the increase in strength obtained when part of the boride is formed by diffusion into metal admixtures.

From the standpoint of consistency, strength and economics, the most promising composition is 67.7 ferroboron (24%B)-32.3% iron powder. This mixture is essentially FeB after sintering. Compacts based on chromium boride with additions of iron, cobalt and nickel are stronger than compacts based on ferroboron. Strengths of sintered bodies are compared with those of graphite and gray iron in a graph.

Strength of 80 chromium boride (CrB_2)-20% iron compacts was nearly tripled by heating in air for two hours at 1300 F. However, heating similar compacts in air at 1650 F decreased their strength. Strength of mixtures of other compositions was not greatly changed by heating in air in the range of 1300 F to 2350 F. Appearance and dimensions of experimental sintered bars were not changed by the reheating treatment.

Compacts made from 80 chromium boride-20% iron were oxidation resistant to 1300 F and above. Those made from 80 chromium boride-10 iron-5% nickel or 80 chromium boride-10 cobalt-5% nickel resisted oxidation up to at least 2370 F.

Borides, like metal powders, can be hot pressed. The compact obtained by this technique conforms to the mold dimensions, thus eliminating shrinkage problems.

Dry powders without binders were used for hot pressing experiments, which were limited to samples of ferroboron (24%B) diluted with iron powder. Cylinders 0.5 in. in dia and 2.0 in. long were pressed at 2550 F and 4000 psi. Floating graphite dies were used. Pressure was released immediately after pressing and the compact was cooled in the die. Tensile strengths of 10,000 to 15,000 psi and densities of 5.0 to 5.4 were obtained on hot pressed objects. Apparent porosities varied between 0.5 and 3.0%. These properties compared closely with those obtained when the same material was cold pressed and sintered.

Parts production

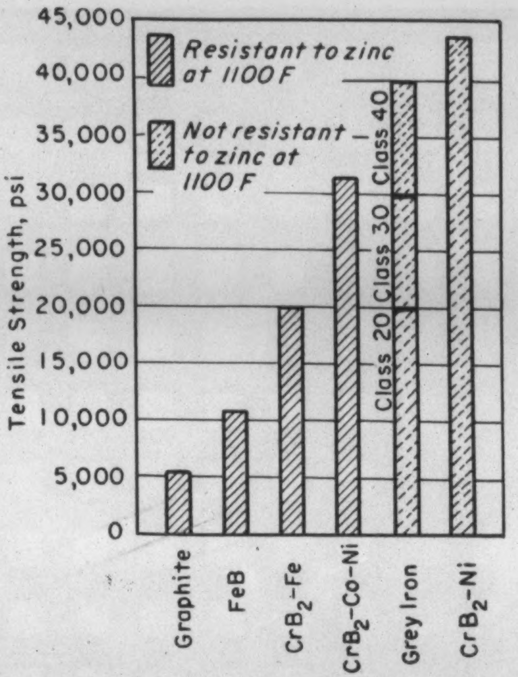
Parts were produced by two methods, hot pressing and a combination of cold pressing and machining.

Angle sections with one leg thicker than the other were produced readily by hot pressing. Die design limited the size of angle produced to about 4 in. Small impellers and propellers were hot pressed in shaped graphite dies successfully. In shapes containing a cored hole, it was necessary to remove the core when the pressure was released to prevent cracking resulting from differential contraction between shape and core.

Propellers and impellers were also made by cold pressing a solid blank and machining the desired shape about 30% oversize before sintering. Presintering and sintering were carried out in the usual manner. For production of parts by this procedure, compacting pressures greater than the normal 11,000 psi gave the most satisfactory results but machining was more difficult than with compacts produced with normal pressure.

Resistance to molten zinc

Sintered bodies were corrosion tested dynamically in a device built for this purpose. Samples attached to tungsten rods with tungsten wire were revolved around a 4-in. dia circle at 12 rpm, giving a speed of travel of about 12.5 ft/min. The zinc was held at 1100 F. Samples were completely immersed in some tests. In others, when the effect of atmosphere was desired, the zinc bath level was lowered to expose part of the sample. Corrosion test periods ranged up to 400 hr.



Comparative strengths *of sintered borides, graphite, and gray iron.*

PROPERTIES OF COLD-PRESSED AND SINTERED COMPACTS[a]

Powder Composition, % by Weight		Intended Boron Content, %	Compacting Pressure, psi	Presinter		Sinter		Calculated[b] Tens Str, psi	Density, g/cm³
Boride	Metal			Temp, F	Time, min	Temp, F	Time, min		
Fe 100	—	—	11,000	—	—	2200	180	1700	2.47
Fe 67.7	Fe 32.2	16	11,000	2600	15	2730	5	10,800	5.45
Mn 90	Fe 10	15.3	11,000	2200	15	2950	15	2600	—
Cr 85	Fe 15	24.6	11,000	2200	15	2900	30	20,000	4.36
Cr 80	Fe 20	—	11,000	2200	15	2900	15 & 30	[c]	5.6 (approx)
Cr 85	Ni 15	—	11,000	2200	15	2900	5	44,000	5.70
Cr 85	Co 15	—	11,000	2200	15	2900	15	14,900	5.86
Cr 85	Ni 5	24	—	—	—	—	—	—	—
	Fe 10	—	11,000	2200	15	2900	15	17,700	5.43
Cr 80	Ni 5	23	11,000	2200	15	2900	10	31,400[d]	6.13
	Co 15	—	—	—	—	—	—	—	—

[a] Specimens 3.0 x 0.345 x 0.3 in. thick before sintering. After sintering 5 min at 2730 F, the dimensions varied considerably. Calculated volume shrinkage 36%.
[b] Tensile strength calcu'ated from modulus of rupture in transverse loading.
[c] Strengths varied widely, from 4600 psi to 13,100 psi, irrespective of sintering time.
[d] Strength of specimens varied from 27,600 psi to 39,800 psi, average 31,400 psi.

Completely resistant to molten zinc at 1100 F were iron boride containing 16 and 24% boron, 85 chromium boride-15% iron powder, 85 chromium boride-15% cobalt powder, 90 manganese boride-10% iron powder, and 80 chromium boride-15 cobalt 5% nickel powder.

After continued exposure to molten zinc the pores of the sintered compacts were filled with zinc but absorbed zinc did not harm the compacts in any way. Zinc could be sweated out and burned without damage.

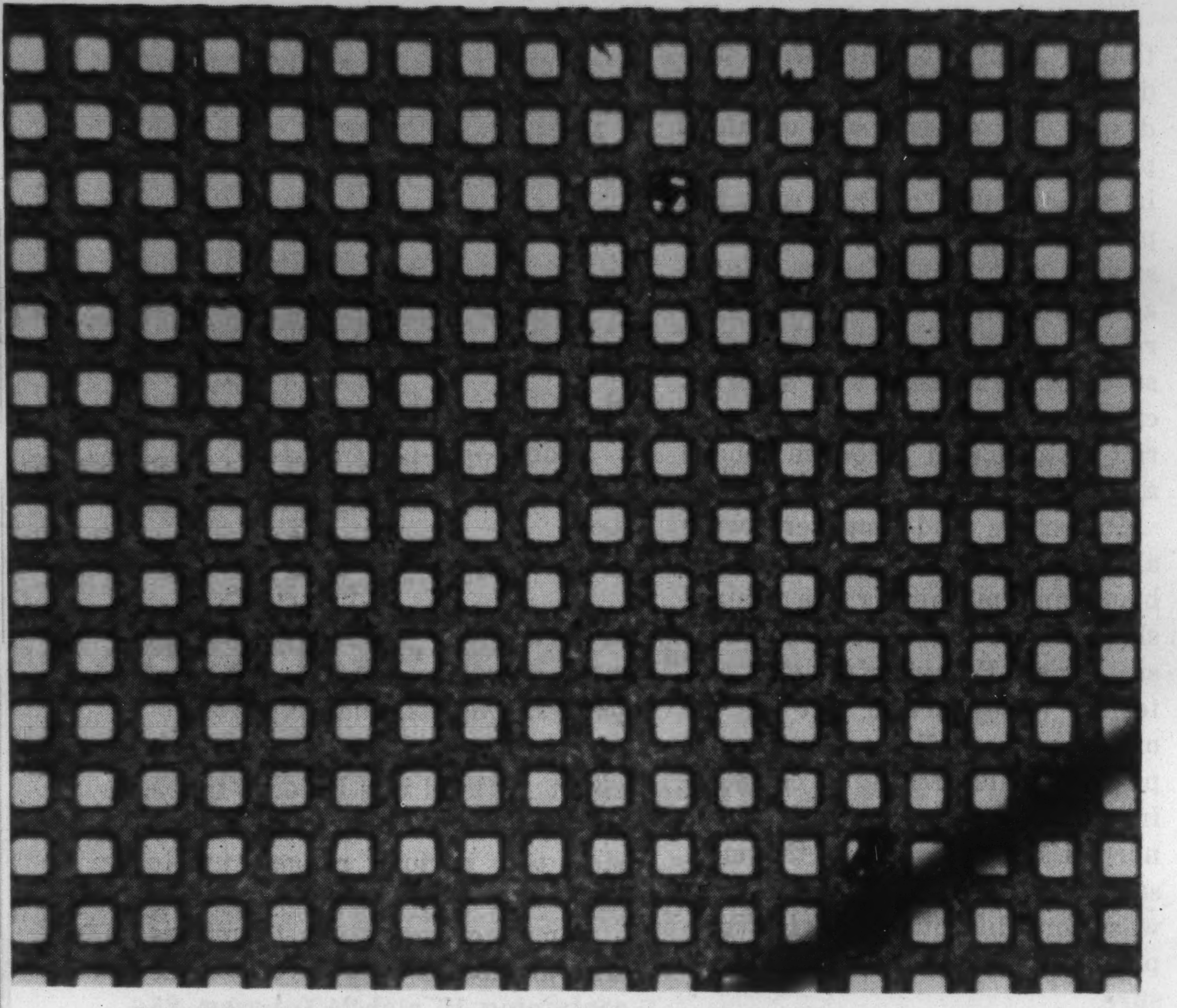
The strongest sintered compacts produced, 85 chromium boride-15% nickel, did not resist attack by zinc. All of the other materials were completely resistant to molten zinc and no relative comparisons were made.

Applications for patent rights covering the novel features discovered in the work on sintered boride have been made by the St. Joseph Lead Co.

Acknowledgments

This article is adapted from a paper presented by Webster Hodge, R. M. Evans and A. F. Haskins as a part of the AIME Chicago Meeting, February 1955. The work, sponsored by the St. Joseph Lead Co., was done at the Battelle Memorial Institute Laboratories.

The author wishes to thank the Zinc Smelting Div. of the St. Joseph Lead Co. for permission to publish this information.



***Precision of holes** is indicated by comparison with human hair.*

This 300-mesh screen produced by

"Chemical Machining" Photosensitive Glass

New development replaces costly machining operations, such as grinding, drilling, cutting, and engraving, and produces patterns often considered impossible in glass.

by Marshall Byer,
Corning Glass Works

■ Production of extremely accurate mechanical and electrical parts, including glass screens with up to 250,000 holes per sq in., has been made practical with a new photosensitive glass. Called Fotoform, the recently developed glass permits forming in finer detail than is possible by all other methods and permits etching of holes to a depth ten times greater than the hole diameter.

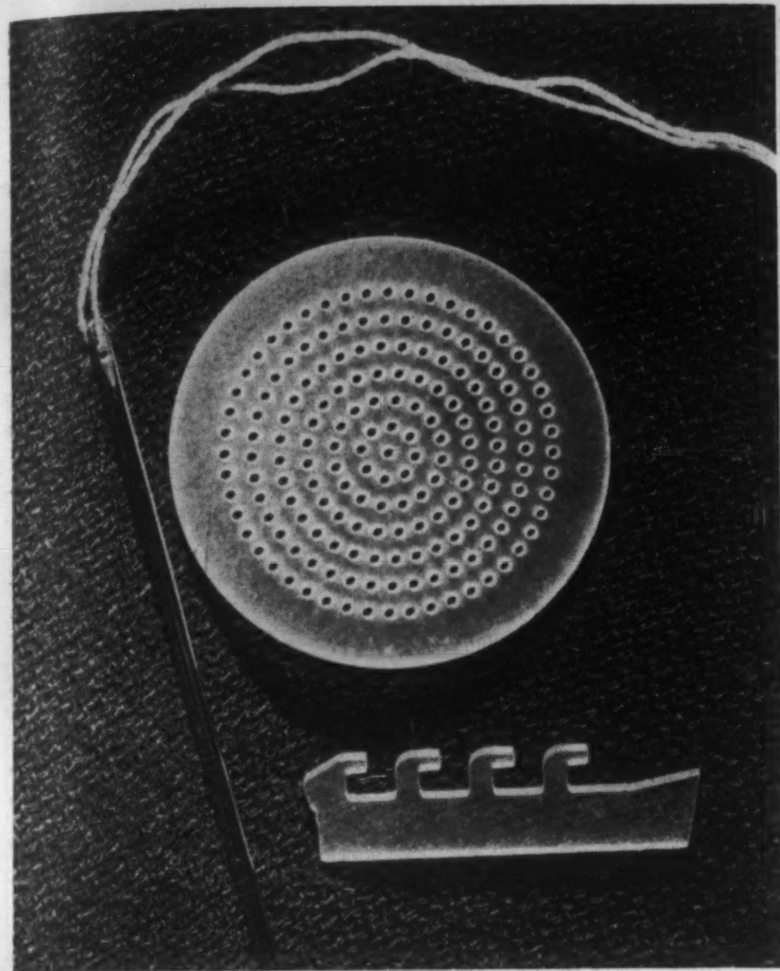
Extreme accuracy of the new glass derives from a high etching ratio (solubility ratio of unexposed to exposed portions of the glass in hydrofluoric acid) of about 15 to 1. Conventional glasses have an etching or solubility ratio of about 1 to 1. Because of this high ratio, holes etched in the new glass have a side wall taper of only 4 deg instead of the 45 deg taper obtained with regular glasses and techniques. This low taper facilitates etching of extremely small, close-tolerance holes with close center-to-center distances. Typical dimensions are shown in Table 1. The hour-glass shape illustrated is obtained simply by exposing both sides of the glass to hydrofluoric acid simultaneously. The conical shape is obtained by sealing off one side with a wax coat so that etching proceeds from the reverse side only.

Types and sizes

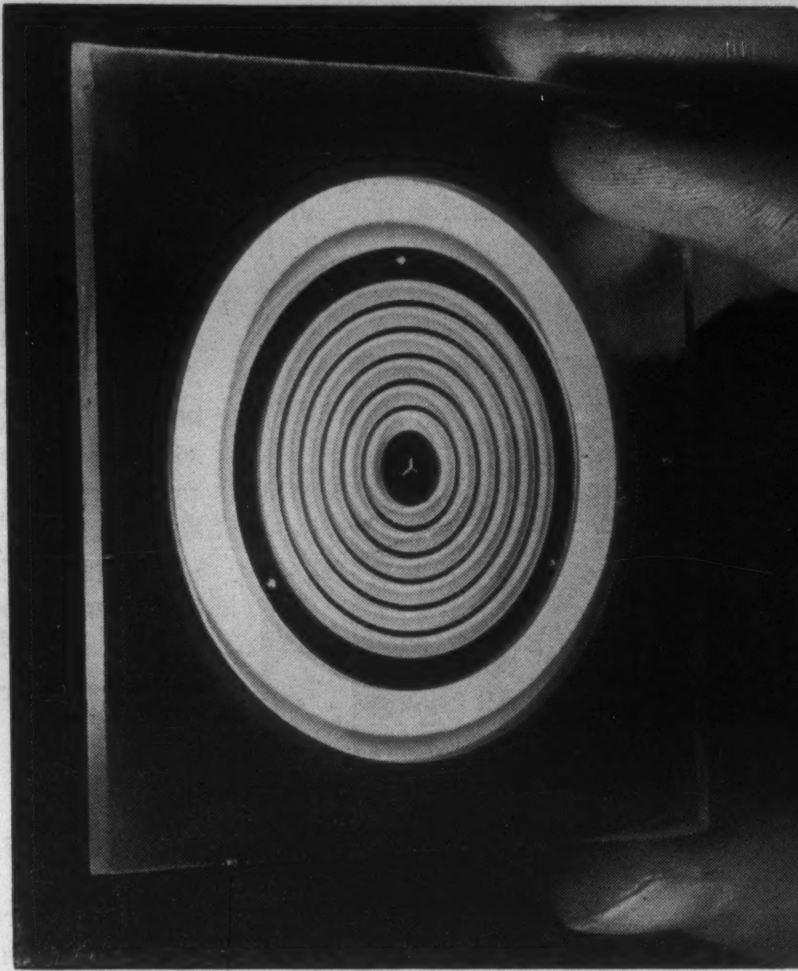
General design considerations are similar to those used with conventional glasses. Since glass tends to fail in tension, components should be designed for compression loading wherever possible.

Ultraviolet exposure and heat treatment of the glass create different glasses varying in structure and properties with the parent glass (see Table 2). The most common forms of the glass after processing are forms B and C. Form B is a clear, unexposed glass that has been heat treated. Form C is glass that has been converted to etchable opal form by exposure to light and subsequent heat treatment. This form, sometimes called Opal Fotoform, has a higher annealing and strain point than the transparent form and can be used at higher temperatures without permanent deformation. It also possesses a higher coefficient of thermal expansion (Table 3).

Following exposure, the treated



Thermocouple holder *(top) and electric relay bar (bottom) dimensions are held to close tolerances after etching.*

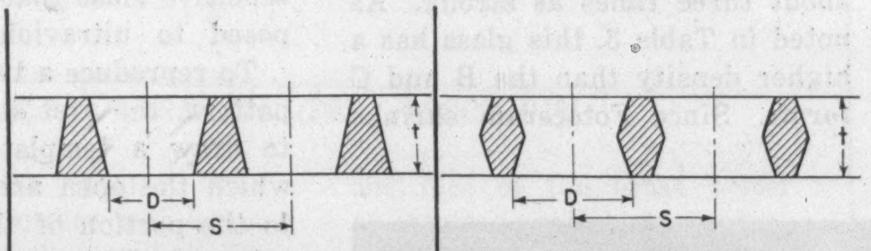


Partial etch *is obtained by withdrawing glass from acid bath before exposed opal portion is completely eaten away.*

piece of glass consists of both forms—C, where light has passed through the negative, and B where it has been masked by the negative. Total etching removes the C form glass. The B form glass remaining is still sensitive to ultraviolet light. Consequently, if a nontransparent glass or different electrical properties are required, the B form glass can be converted to the opal C form by re-exposure to the light source. To prevent conversion of the entire piece to opal glass, a negative may be used to selectively expose portions for the desired resistivity or transparency pattern.

Presently, the glass is made only in sheet form and in standard thicknesses (before etching) from 0.055 to 0.250 in. Nonstandard thicknesses can be obtained by grinding. For thicknesses greater than 0.250 in., the glass may be laminated with a suitable epoxy cement. Alignment holes

TABLE 1—TYPICAL TOLERANCES AND SPACINGS FOR ETCHED HOLES



	One Side Etch						Two Side Etch					
Nominal thick. before etch (t) in.	0.055	0.080	0.125	0.150	0.180	0.250	0.055	0.080	0.125	0.150	0.180	0.250
Min Clearance (S-D), in.	0.007	0.010	0.015	0.019	0.022	0.031	0.003	0.005	0.008	0.009	0.011	0.016
Hole dia (D) in.	Spacing, (S), in.						Spacing, (S), in.					
0.006	0.013	....	....	....	....	....	0.009	....	....	....	....	....
0.010	0.017	0.020	....	....	....	....	0.013	0.015	....	....	....	....
0.015	0.022	0.025	0.030	0.034	....	....	0.018	0.020	0.023	0.024	....	....
0.020	0.027	0.030	0.035	0.039	0.042	....	0.023	0.025	0.028	0.029	0.031	....
0.025	0.032	0.035	0.040	0.044	0.047	0.056	0.028	0.030	0.033	0.034	0.036	0.041
0.050	0.057	0.060	0.065	0.069	0.072	0.081	0.053	0.055	0.058	0.059	0.061	0.066
0.100	0.107	0.110	0.115	0.119	0.122	0.131	0.103	0.105	0.108	0.109	0.111	0.116
0.250	0.257	0.260	0.265	0.269	0.272	0.281	0.253	0.255	0.258	0.259	0.261	0.266
0.500	0.507	0.510	0.515	0.519	0.522	0.531	0.503	0.505	0.508	0.509	0.511	0.566

Hole Tolerances, in.	Center-to-Center Tolerances, in.	Edge Tolerances, in.
Up to ¼ dia ±0.001	0 to 1 ±0.001	0 to 1 ±0.002
¼ to 1 dia ±0.002	1 to 4 ±0.003	1 to 4 ±0.005
Over 1 dia ±0.005	4 to 7 ±0.005	Over 4 ±0.010

Special lighting effects *are obtained by using brown-black opaque glass in combination with clear glass. Applications include multicellular lights, directional louvering and chopper discs.*

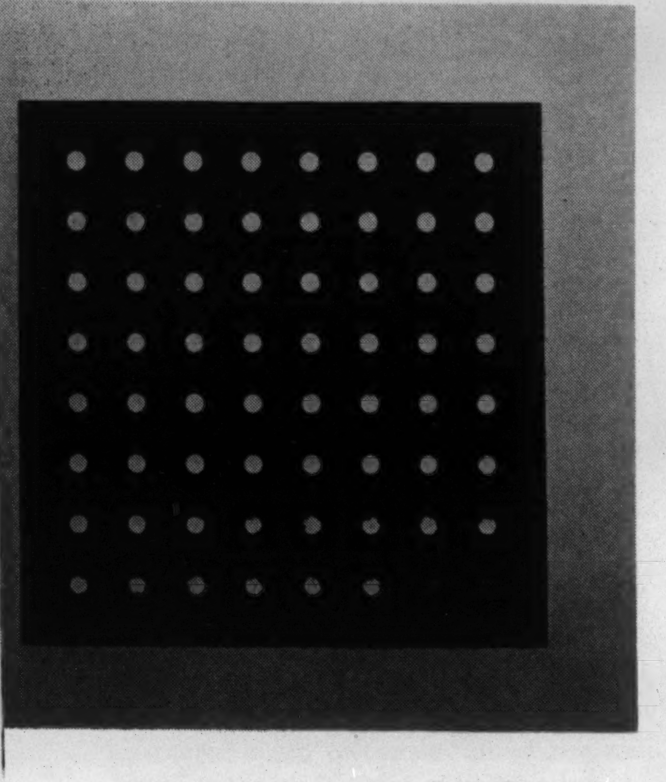


TABLE 2—TYPES OF FOTOFORM GLASS

A	Unprocessed glass.
B	Clear, heat treated glass that has not been exposed to ultraviolet light. This is also the glass that remains after etching has been completed.
C	Glass that has been converted to the etchable opal form by exposure to ultraviolet light and heat treatment. This form is used where opacity or high electrical resistivity is required.
D	A glass panel that is a combination of the B and C types. The C areas may be partially etched. Type D is used where both high and low resistivity areas are required in the same piece of glass, or else to obtain partially recessed designs.
E	Brown-black opaque glass. This type can be used for multicellular lights or in combination with the B form for directional louvering, chopper disks, etc.
Fotoceram	Processed glass that has the same electrical properties as type C, but higher strength, melting point (1607 F) and thermal expansion. Dimensional accuracy, however, is lower.

for pin location can be etched in each laminate.

By proper exposure and development, Fotoform can be converted to a highly crystalline material resembling a ceramic. Called Fotoceram, this glass is much harder than ordinary glasses and about three times as strong. As noted in Table 3, this glass has a higher density than the B and C forms. Since Fotoceram shrinks while cooling, the final shape is smaller than the original. Larger tolerances are usually necessary since the shrinkage rate from piece to piece is not uniform, but work is underway to bring the shrinkage rate under control.

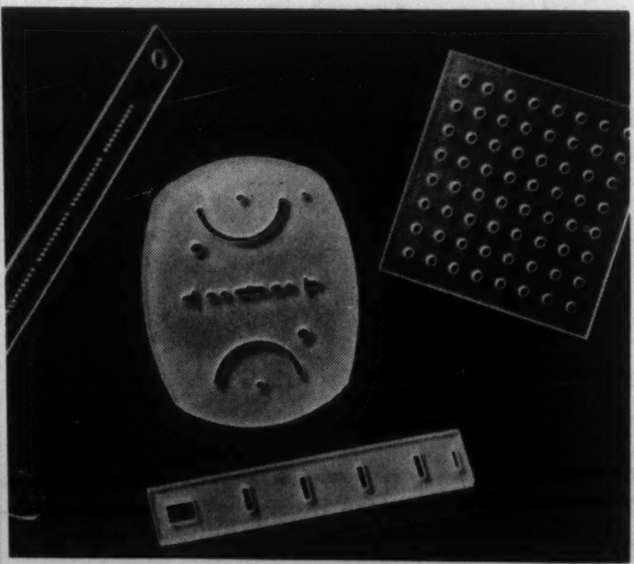
How "chemical machining" works

The photochemical or "chemical machining" method of forming glass is based upon a differential etching process which dissolves away those portions of photosensitive glass that have been exposed to ultraviolet light.

To reproduce a two dimensional pattern, the first step required is to draw a template or mask in which the open areas correspond to the portion of the glass to be removed. For precision work this pattern is usually drawn many times oversize and reduced photographically to the final size required.

The photographic negative is then placed over a piece of the parent glass and exposed to a collimated ultraviolet light source. Subsequent heat treatment of the glass for approximately one hour causes the exposed portion of the glass to crystallize, forming an opal image in an unexposed clear glass background.

The exposed portion of the glass has a rate of solution in dilute hydrofluoric acid approximately 15 times that of the clear unexposed glass and can be either partially or completely etched out. If both sides of the glass are etched simultaneously, a hole with an hourglass cross-section is formed. Conical cross-sections are



Stylus guide *(left), vacuum tube spacer (upper), relay pusher bar and 64-hole perforated plate typify small components that can be etched from photosensitive glass.*

TABLE 3—MECHANICAL AND ELECTRICAL PROPERTIES OF FOTOFORM GLASSES

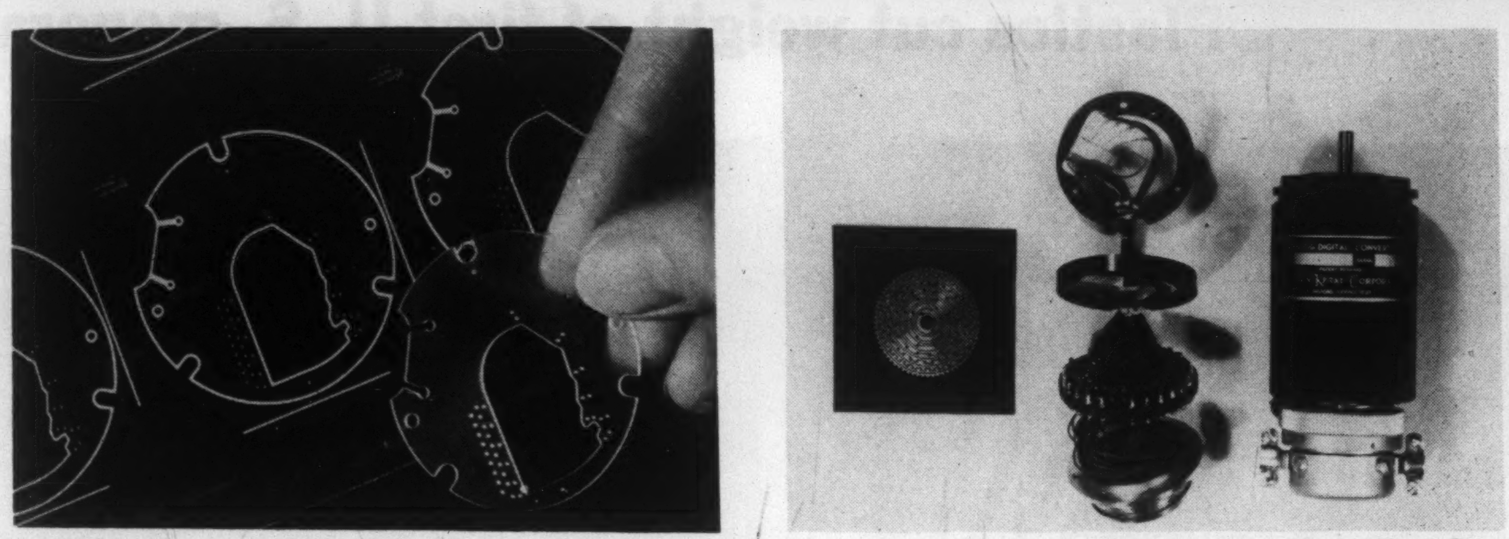
	Type B	Type C	Fotoceram	Soda Lime Glass	Borosilicate Glass
Coefficient of thermal expansion, F	46×10^{-7}	48×10^{-7}	58×10^{-7}	51×10^{-7}	18×10^{-7}
Annealing point, F	846	1173	—	950	1031
Strain point, F	846	1087	—	892	959
Specific gravity	2.36	2.36	2.45	2.47	2.23
Resistivity at 77 F, ohm-cm	5×10^{12}	6×10^{15}	6×10^{15}	1×10^{11}	3×10^{13}
Modulus of elasticity, psi	10×10^{6}	10×10^{6}	10×10^{6}	9.8×10^{6}	9.8×10^{6}
Poisson's ratio	0.22	0.22	0.22	0.22	0.22
Allowable working stress in tension, psi	1000	1000	3000	1000	1000

obtained by wax coating one side of the glass so that the acid etches from the opposite side only.

Variations of the waxing technique can also be used to produce more elaborate shapes. Blind holes or slots can be combined with through holes or slots in the same piece of glass. This is done by waxing off both sides of the blind holes and etching the through holes from either one or both sides. When the through holes are etched out, the glass is taken out of the acid and the wax removed from the blind holes on one side of the glass. The glass is then placed in the acid bath and the blind holes etched to the required depth. Final finishing operations, such as grinding, polishing, metallizing or laminating, differ very little from those used with ordinary glass.

Applications

The new glass has been used experimentally for a number of applications including relay pusher bars, stylus guides, thermocouple wire guides, jigs for detailed assemblies and screens in electronic storage tubes. Previously, copper screens coated with a thin dielectric had been used as electrostatic capacitive elements in storage tubes. To obtain a relatively thick dielectric, development is proceeding with a glass screen coated with a conductor. Standard screens are presently available in 50 and 300 mesh sizes in thicknesses from 0.004 to 0.055 in. A 500 mesh screen is under development and several have been made on an experimental basis.



Norden-Ketay Corp.

Brush holder *for digital converter is etched from one side to produce conical holes. In background is plate containing several holders, it has been exposed and developed but not etched. At right is digital converter and harness assembly, consisting of two brush holders and terminal board.*

Glass Chosen for Accurate Brush Holder Assembly

The extreme accuracy of etched Fotoform glass accounts for its use in a number of precise assemblies where close linear dimensions and tolerances are required. The use of glass as a brush holder in a small, lightweight, airborne digital converter (above) is typical of these applications. This device converts rotary shaft motion into a binary number by means of wire brushes which ride on flush contact circuits driven by the rotating shaft. To insure reliability, two wire brushes ride each commutator section.

Originally the converter was manufactured with 0.0065-in. dia single wire brush contacts and a glass fiber reinforced plastic laminate brush holder. The laminate was drilled with 0.015-in. dia holes, the smallest size that could be drilled in the original laminate material. Since the wires fitted loosely in the relatively large holes, a secure wire mount and accurate positioning of the brush contacts was difficult to obtain.

The solution to this problem was made by redesigning the brush holders to take advantage of the properties of the photosenstive glass. The redesigned holder is now provided with rectangular holes, 0.0075 by 0.015 in., and the two 0.0065-in. dia wires inserted side by side in each hole.

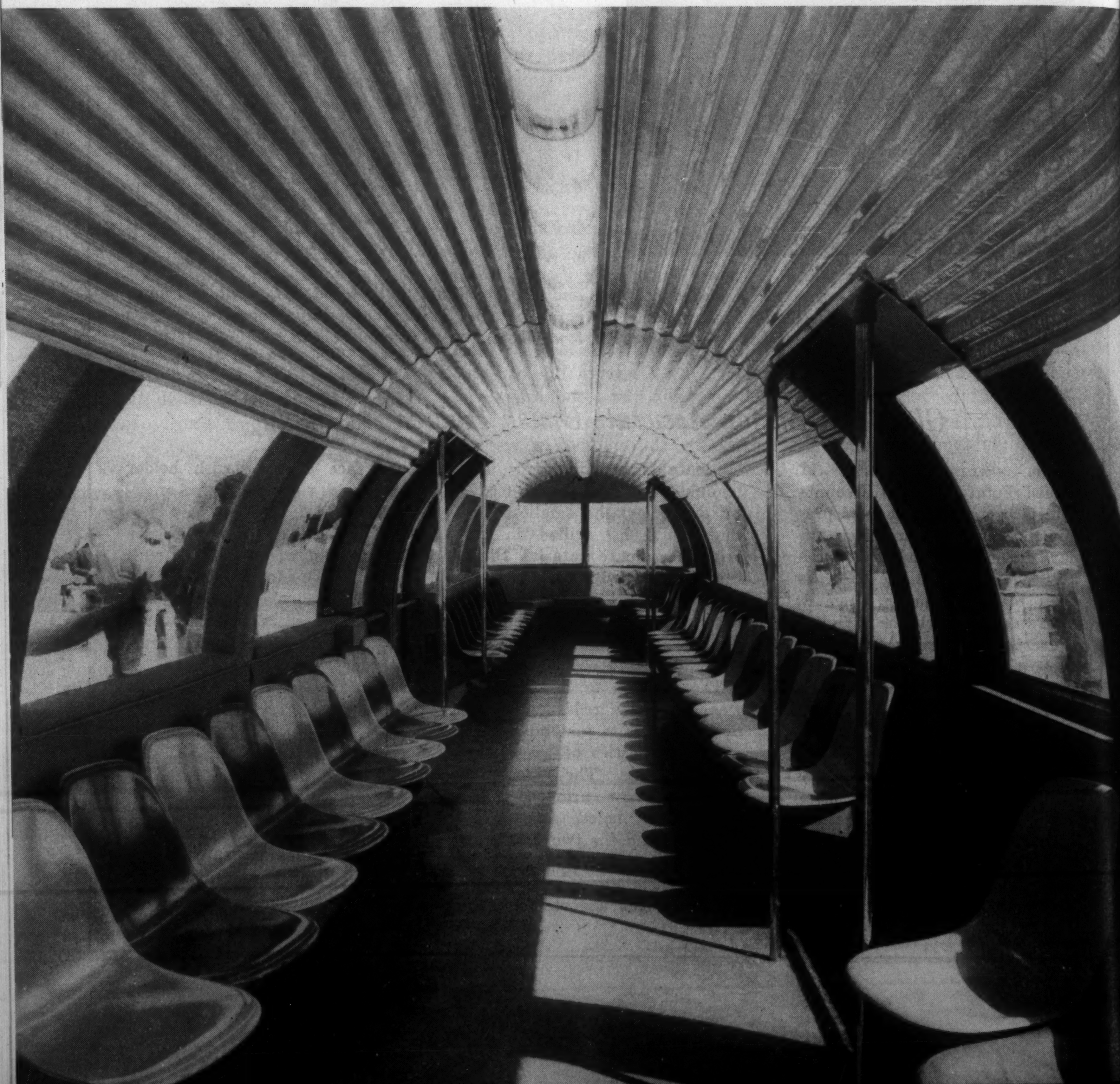
These holes are etched from one face of the brush holder to obtain a conical shape cross-section. The lip of this section provides a sharp reference plane about which the free ends of the brush cantilever. Spacing of brush holder slots is held to a tolerance of ±0.001 in. over a distance of almost 1½ in. Thus, the high accuracy achieved in the location and size of the rectangular holes makes possible the positioning of the double brush contacts within close tolerances. An etched glass alignment plate is also used during assembly to locate the free ends of the brushes accurately while the fixed ends are cemented to the brush holder.

The first U. S. monorail runs for only 970 ft, but others like it are expected to solve mass transportation problems. Except for its length, the experimental monorail in Houston is a full-scale system. Called the Skyway, it uses fundamentally the same principle as the monorail in Wuppertal, Germany, which since 1903 has carried more than 900,000,000 passengers without a fatal accident.

But to compare the noisy, 25-mph German Schwebebahn to the Texas Skyway is said to be like comparing a Model T to a 1956 automobile. With two 305-hp gasoline engines, the Skyway is built to go 60 mph

Materials At Work

Plastics cut weight of first U. S. monorail



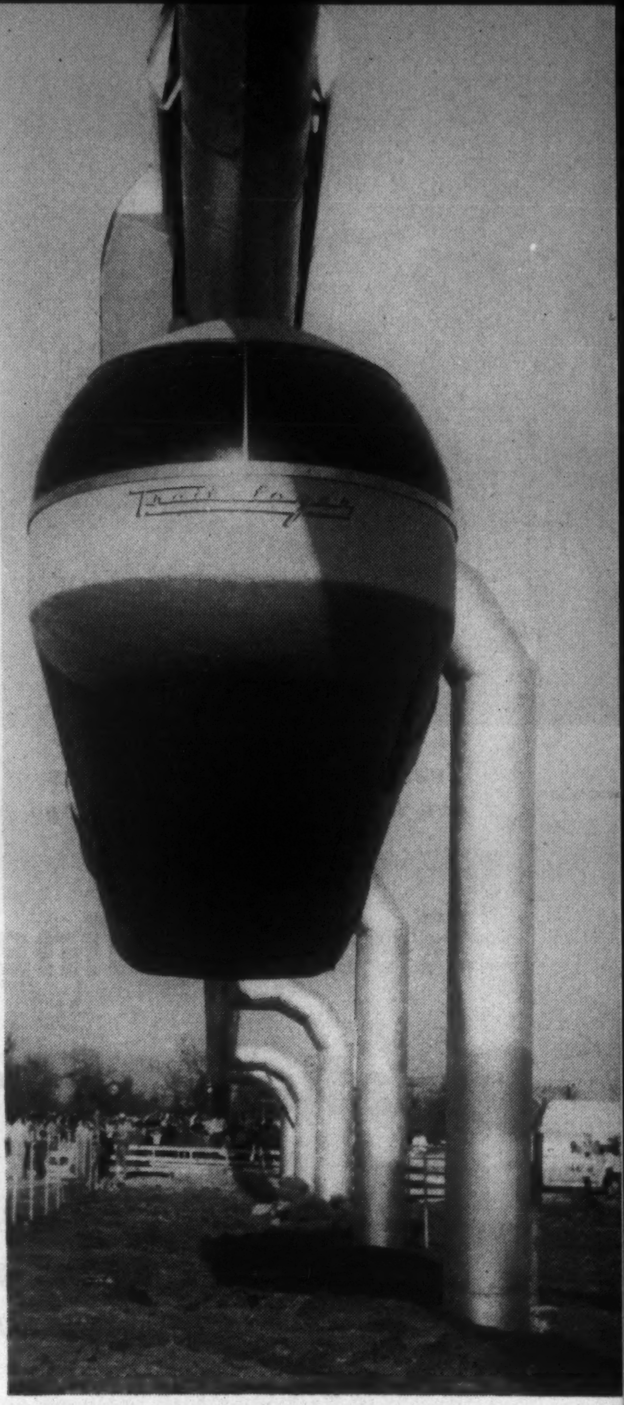
and its passengers find it no more noisy than a modern elevator.

The exterior of the pilot line coach is covered with about 3000 sq ft of fiber glass reinforced plastics. This is believed to be the largest commercial use ever made of the material. The windows are made of acrylic plastics, but in its future models, Monorail, Inc., is planning to install Solar-Glass.

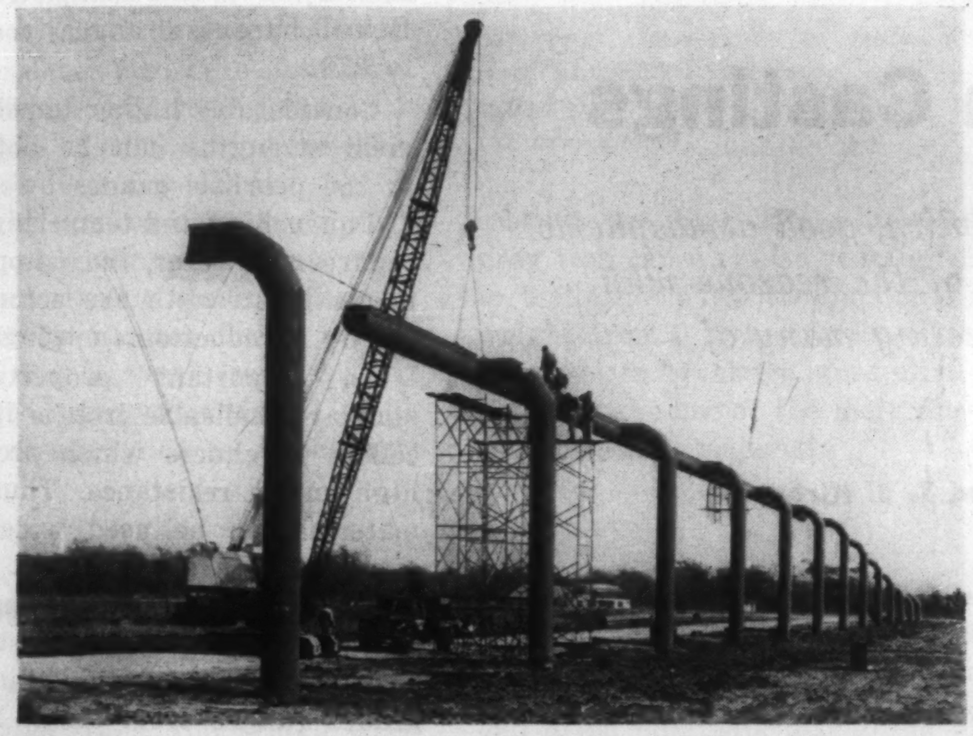
The ceiling in the coach is paneled with glass fiber reinforced plastic held in place by fluted aluminum braces. Designed by Charles Eames, the seats are constructed of an extremely durable plastic, reinforced with glass fibers. The seating arrangement is patterned after the modern bus system in Stockholm. The coach, 7 ft high, 8 ft wide, 55 ft long, seats 60 and can provide standing room for 50 more.

The coach weighs about 26,700 lb. This is about 400 lb per passenger and compares with 1000 lb per passenger on a bus and 2500 lb for railroad coaches.

From the experience gained in building this $150,000 line, Monorail, Inc., states that it can construct commercial monorail systems for about $500,000 a mile at the rate of 1 mile a week. This is twice the cost of laying railroad tracks, but less than for a subway.



Possible speed *of Skyway is 250 mph underground or overhead. Steel frame of coach utilizes "concentric suspension."*



Towers *have inverted J-shape to cantilever over streets. Highest tower is 30 ft, lowest 10 ft. Hollow steel 30-in rail was tested with 30-ton army tank. Coach filled with passengers weighs about 15 tons.*

"Power nacelle" *is being fitted to coach. Nacelle contains the wheels, two 305-hp gasoline engines, braking system and interlocking guide rails. Later nacelle, towers and rail were given an aluminum coating.*

Tower here *is 10 ft high. Eight rubber tires on track are nylon blowout proof. Should anything happen to them, eight auxiliary steel wheels take over.*

Evaluating the capabilities *of malleable iron in the early design stages can lead to lower materials and production costs.*

Redesigning for Malleable Iron Castings

Toughness, excellent machinability, good atmospheric corrosion resistance are some of the reasons why malleable iron castings are meeting many of industry's needs.

by D. B. Fulton, J. R. Entenmann and T. J. Kirby,
Northern Malleable Iron Co.

■ The successful application of malleable iron castings depends on proper evaluation of their properties. Among the most useful characteristics are toughness, ductility and good resistance to atmospheric corrosion. Malleable irons also have excellent machinability and casting properties, which make possible sound castings in complicated as well as simple forms.

Most malleable iron castings are produced in two standard grades. However, the production of pearlitic malleable castings, although small when compared with the total tonnage of the standard grades, is increasing rapidly because of the wide range of mechanical properties obtainable. Two standard and seven pearlitic grades covered in the ASTM specifications are given in a table. Code numbers of the grades indicate yield strength and elongation. Thus, grade 32510 has a minimum yield strength of 32,500 psi and a minimum elongation of 10% in 2 in. Tensile strength of the various grades ranges from 50,000 to 100,000 psi while elongation decreases from 18 to 2% with increasing strength. Brinell hardness ranges from 110 to 270.

Considerably higher tensile and yield strengths can be obtained in the pearlitic grades by standard quenching and tempering procedures. However, these improvements in strength are accompanied by a reduction in elongation.

An important property of standard malleable iron is its excellent toughness which provides high impact resistance. Thus, the material can be used widely in applications where the part must resist shock loading. As measured by the standard Charpy test, impact resistance of the standard grades ranges from about 12 to 17 ft-lb. The ductility of the pearlitic grades is lower than the standard grades. Therefore, as expected, impact resistance is also lower.

Malleable iron castings are used widely in many fields of industry. About half the production goes to the automotive industry but considerable quantities are used also in aircraft, agricultural equipment, hardware, appliances, railroad equipment, machinery and electrical equipment. The excellent properties described above lead also to the use of malleable iron castings to replace certain other types of parts. These include weldments, forgings, gray iron castings and steel castings.

MALLEABLE IRON GRADES

Grade	ASTM Spec	Tensile Str, psi (min)	Yield Point, psi (min)	Elong in 2 in., % (min)	Brinell Hardness Range[a]
STANDARD					
32510	A47-52	50,000	32,500	10	110-145
35018	A47-52	53,000	35,000	18	110-145
PEARLITIC					
45010	A220-55T	65,000	45,000	10	163-207
45007	"	68,000	45,000	7	163-217
48004	"	70,000	48,000	4	163-228
50007	"	75,000	50,000	7	179-228
53004	"	80,000	53,000	4	197-241
60003	"	80,000	60,000	3	197-255
80002	"	100,000	80,000	2	241-269

[a] Not a requirement of the specification.

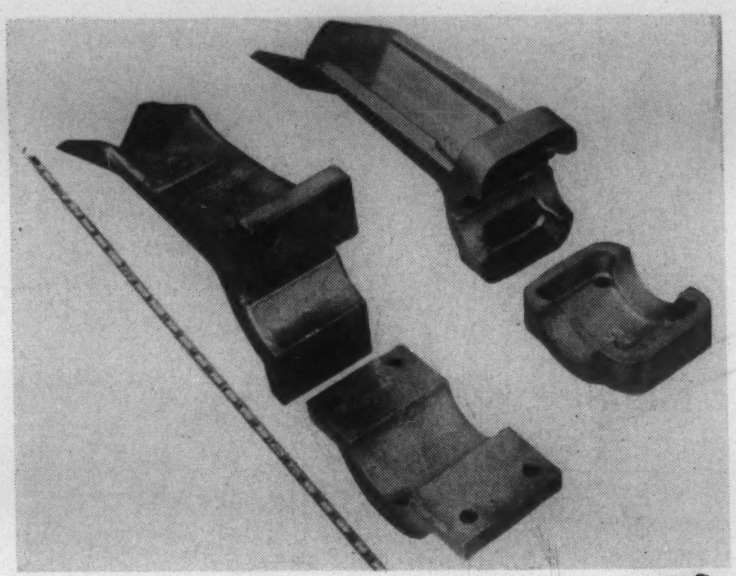
Malleable proved successful for these parts:

Conversion from Gray Iron

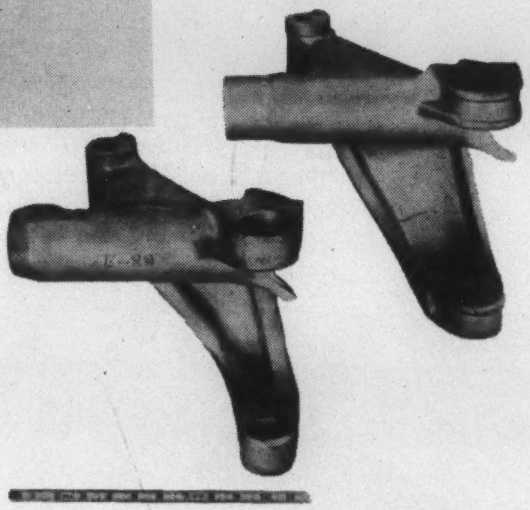
An error that frequently occurs in the design of a new casting is the selection of gray iron for use in applications that require ductility. In this case the part is designed with extra heavy sections that are intended to carry the load under average service conditions. However, a sudden shock load sometimes causes such parts to break.

A mower sickle bar hinge was originally made of alloy gray iron and weighed approximately 38 lb. When this part was converted to malleable iron the weight was reduced approximately 10 lb and failures that had occurred under sudden shock load were eliminated.

Breakage can also occur in a gray iron casting during assembly because it is not ductile. Shown at right on this page are a gray iron cap and arm that were clamped about a shaft. Breakage frequently resulted during assembly. The gray iron casting weighed approximately 31½ lb. It was redesigned to a malleable casting weighing 23½ lb. The gray iron cap was also redesigned to malleable with a reduction in weight from 9 lb to 5¾ lb. Failures due to breakage were eliminated by the use of the more ductile malleable material.



Cap and arm *produced originally in gray iron sometimes broke during clamping. Conversion to malleable iron eliminated breakage and resulted in a weight saving of 8 lb in the arm and 3¼ lb in the cap.*



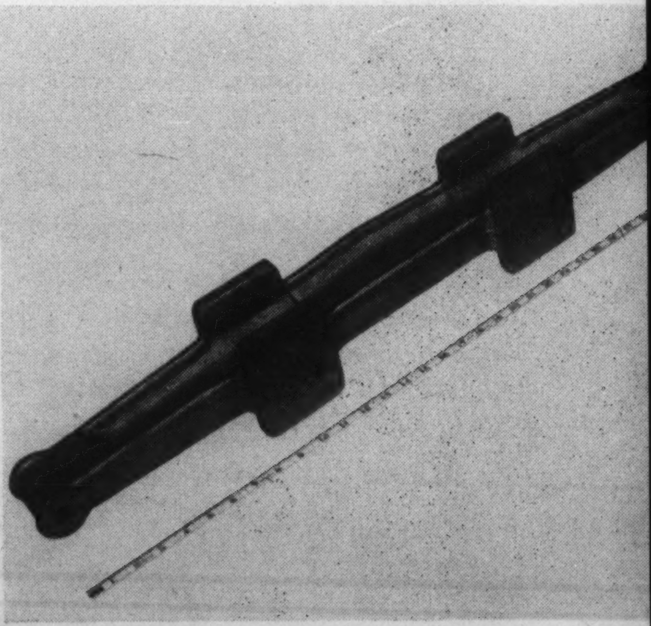
Mower sickle bar hinge *converted from gray iron (left) to malleable iron resulted in a reduction in weight from 38 to 28 lb.*

Conversion from Forgings

By the development of pearlitic malleable irons, the design engineer has achieved greater freedom in the area of high strength parts and thus can sometimes replace forged parts by castings of their materials. The cost of forging dies makes relatively short run production parts economically undesirable. This is not the case with pearlitic malleable iron since a proper grade to be used in a part can be cast from relatively low cost patterns.

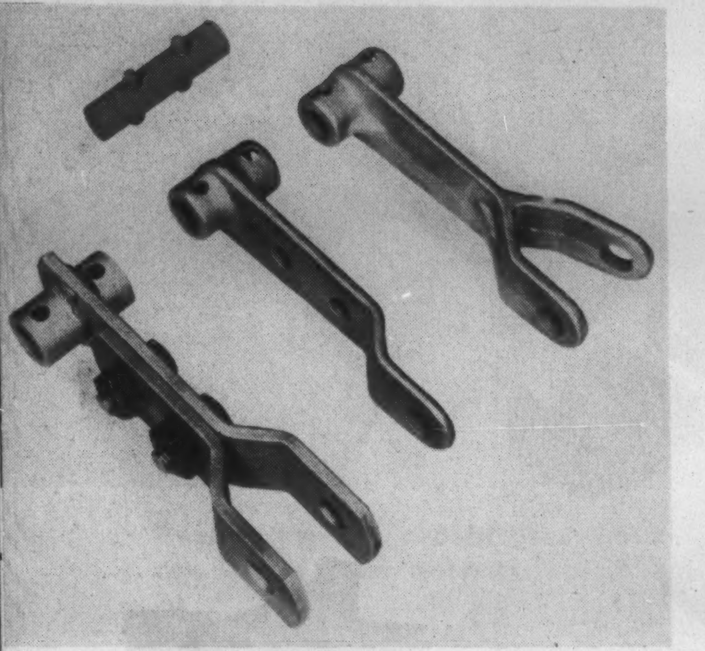
There are a number of advantages in making this conversion. Castings normally require less than half the draft needed for forgings. This saves materials and machining if done on a draft surface. There is a further advantage in weight reduction through proper design. Coring can often eliminate machining of internal areas and holes. As a further advantage, pearlitic malleable iron is more readily machined than the usual steels that would be replaced. Pearlitic malleable iron has been used to replace forgings in automotive rocker arms, crankshafts and axles.

The axle shown in an accompanying figure was formerly a forging to which four steel plates were welded. Total cost including machining was approximately $23. The malleable casting costs only $12.50 including machining. Similarly, a reduction of 20¢ per piece was achieved by changing from a forged crank shaft to a malleable casting. In both cases grade 35018 malleable iron was used.

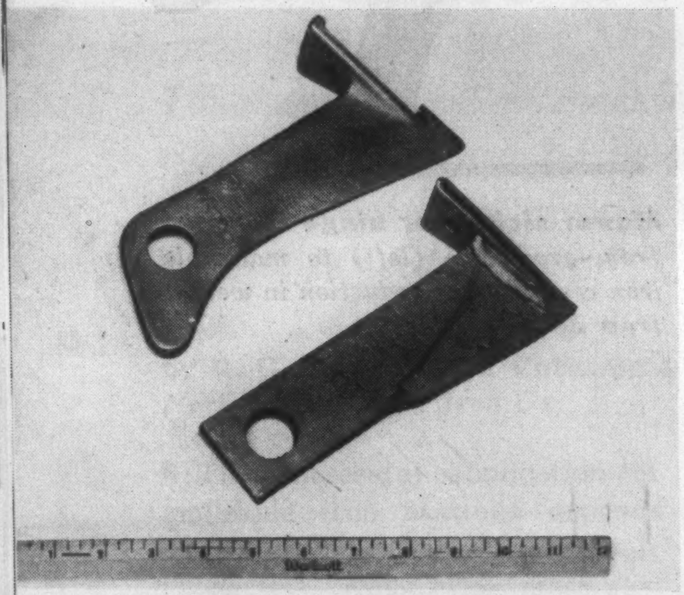


Axle *originally produced as a forging to which four steel plates were welded cost approximately $23 including machining. Completed cost of the malleable iron replacement is $12.50.*

Conversion from Weldments

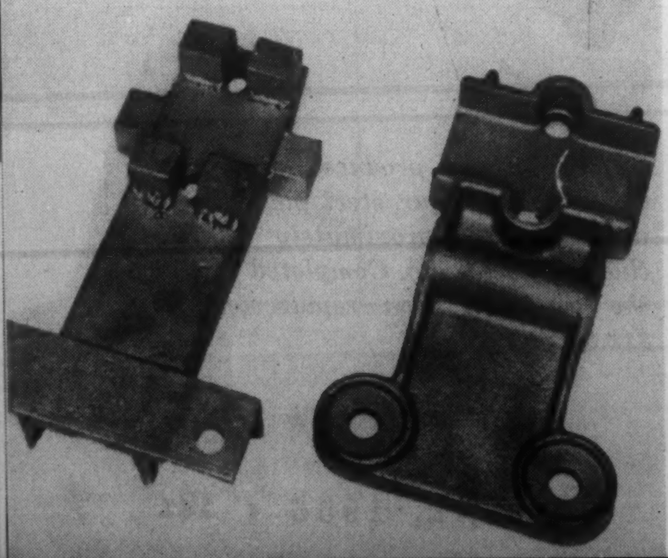


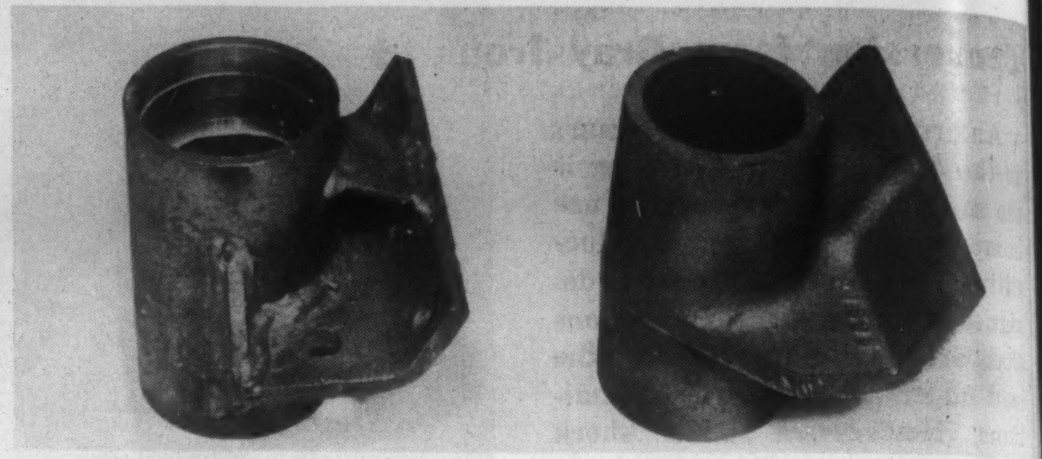
Arm *converted in two stages from a bolted weldment to a bolted malleable iron casting and then to a single malleable iron casting.*



Shredder hammers *converted from weldments (bottom) to castings have eliminated build-up of soil at the angle of the tee because of smoother configuration of the part.*

Knife holder *conversion from weldment to malleable iron casting reduced cost of this part by eliminating a number of hand operations.*





Bearing housing *conversion from a weldment to a casting reduced the cost from $1.84 to $1.41 per piece.*

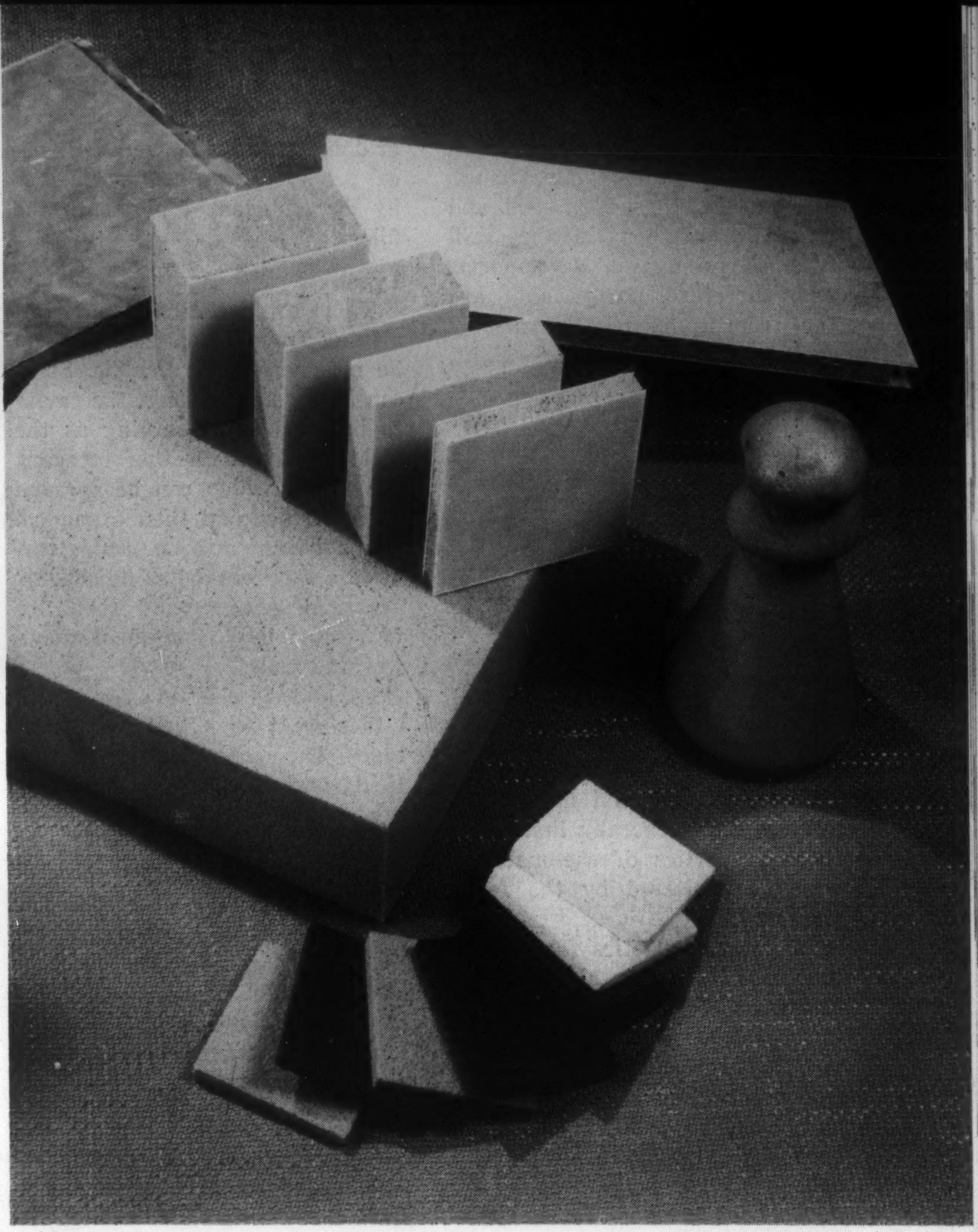
Often parts are designed as weldments without any true idea of the cost of the part. Considering only the cost of raw materials and direct labor to weld a few simple components, a price may appear to be quite reasonable. However, the cost of a weldment should include the particular cutting, stamping, shearing, breaking and waste material cost necessary to produce the component. Further, production welding requires properly made fixtures and jigs that often are equivalent to or greater in cost than the pattern equipment required to produce a casting.

Castings also have certain inherent advantages over some kinds of weldments. Complicated weldments have a tendency to warp and before assembly must be either straightened or machined whereas the casting can be produced closer to the final shape. Whenever it is necessary to weld a number of pieces together to form a single assembly there is always a problem of maintaining consistently good welds at all the joints.

Another advantage in castings is the possibility of eliminating weight by modifying the design. Bearing surfaces usually determine the over-all plate dimensions used in weldments. This is not necessary in a casting. The metal can be placed where needed, using bosses, thus reducing the total cost of the part. Required machining can often be reduced also by coring the casting to provide internal cavities at low cost.

Several examples of the savings made by the conversion from weldment to malleable iron castings are given in the accompanying illustrations. A weldment made from 1020 steel can be duplicated by a malleable casting of equal metal section. Pearlitic malleables compare favoraby with steels of higher properties. For instance, a bearing housing shown in an accompanying figure was originally made by welding a bracket onto the side of a piece of pipe. The cost of the weldment, including labor and material, was $1.84. The component shown to the left, a malleable iron replacement, cost $1.41, including machining.

Another example is the yoke shown in an accompanying illustration. The arm was originally designed as a weldment and a formed steel strap was bolted to it to complete the yoke end. The tubing had to be reamed because of distortion in welding and the four small holes had to be drilled for roll pins. The arm was converted to malleable iron as shown in the center illustration and all machining was eliminated by the use of cores. For some time the customer continued to bolt the steel strap to the casting for assembly of a trunnion within the yoke. However, eventually the design shown to the right was developed. In this case the yoke end is cast with an offset. After trunnion is inserted, yoke is closed cold permanently in assembly.



Dow Corning Corp.

Urethane
Vinyl
Polyethylene
Polystyrene
Phenolic
Silicone
Syntactic
Cellulose Acetate
Epoxy
Urea Formaldehyde

Foam Plastics

by Walter Brenner, *Director of Research, East Coast Aeronautics, Inc.*

Here is the most up-to-date information on the ten types of commercially available plastics foams. Materials include flexible, rigid-foamed in place, and rigid-prefoamed cellular resins. Though data are far from complete on these new materials this manual discusses:

- *Chemical composition*
- *Physical and mechanical properties*
- *Forming and fabrication*
- *Applications*

MATERIALS & METHODS MANUAL No. 127

This is another in a series of comprehensive articles on engineering materials. These sections provide the reader with useful data on characteristics and uses of materials, parts and finishes.

JUNE 1956

■ Expanded, cellular, or foamed plastics are new materials. Though a great deal has been said and written about them, they are still in an early stage of development and, therefore, design data are far from complete. Present-day demands for lighter-weight, stronger materials and for materials with better energy absorption characteristics are hastening the study of these unique materials so that they can be properly engineered for most effective use.

Foamed plastics are resinous materials of a porous or cellular structure. They can be fabricated to suit many end-uses. Because foams are formed from basic resins, many of their properties are governed by those of the resin. In this manual, therefore, discussion of physical and mechanical properties is generally limited to those properties of the material which are altered by the foam structure.

In general, plastics foams feature good thermal insulation properties, excellent electrical characteristics and favorable strength-to-weight ratios. Mechanical properties, as well as being dependent on the type of resin, vary with the type of cell structure and the density of the foam. Density of commercial foams currently available ranges from less than one to over 40 lb per cu ft. Higher strengths are obtained with higher densities and vice versa. Physical properties can also be affected by the addition of pigments and fillers.

Types

There are several ways of classifying foamed plastics. They can be either *rigid* or *flexible*. Some can be *foamed-in-place*, the cavity to be filled often serving as the mold. Included in this category are foams which can be sprayed on a surface and then expanded. Other types must be *prefoamed*. They are purchased as finished or as rough shapes, and then are fabricated by conventional woodworking tools.

Expanded plastics can have either *open* or *closed cell* structures. This characteristic is particularly important in determining buoyancy characteristics, since open celled or interconnected type foams absorb liquids. It is also important in acoustical insulation applications, since closed cells tend to reflect sound rather than absorb it. The biggest application of open-cell flexible foam is cushioning and padding for comfort and safety purposes.

Resins

Foams currently attracting most commercial interest are the urethanes, both flexible and rigid, the flexible vinyls, and the rigid polystyrenes. Other foams, which are out of the laboratory stage, but are not yet commercially prominent, are based on cellulose acetate, phenolic, silicone, epoxy, polyethylene and urea formaldehyde resins. The purpose of this manual is to present, as fully as present-day data allow, the properties and characteristics of all these materials, so that the engineer or designer will know what materials are available and what they can do.

The resins are divided into three main categories:

1. Flexible: Urethane and vinyl foams can be produced as flexible or semi-rigid materials. Cellular polyethylene is considered only as a flexible material, though it has a higher degree of rigidity than conventional polyethylene.

2. Rigid, Foamed-in-Place: This category contains one of the polystyrene formulations, rigid urethanes, phenolics, silicones and syntactic foams. The similar characteristic of all these foam materials is that the formulations can be purchased, and the materials foamed or cast to shape by the user. All of the resulting foams are rigid.

3. Rigid, Prefoamed: The remaining resins, the other polystyrene formulation, cellulose acetate, epoxies and ureas, are rigid materials, usually foamed by the supplier and purchased as finished or rough shapes.

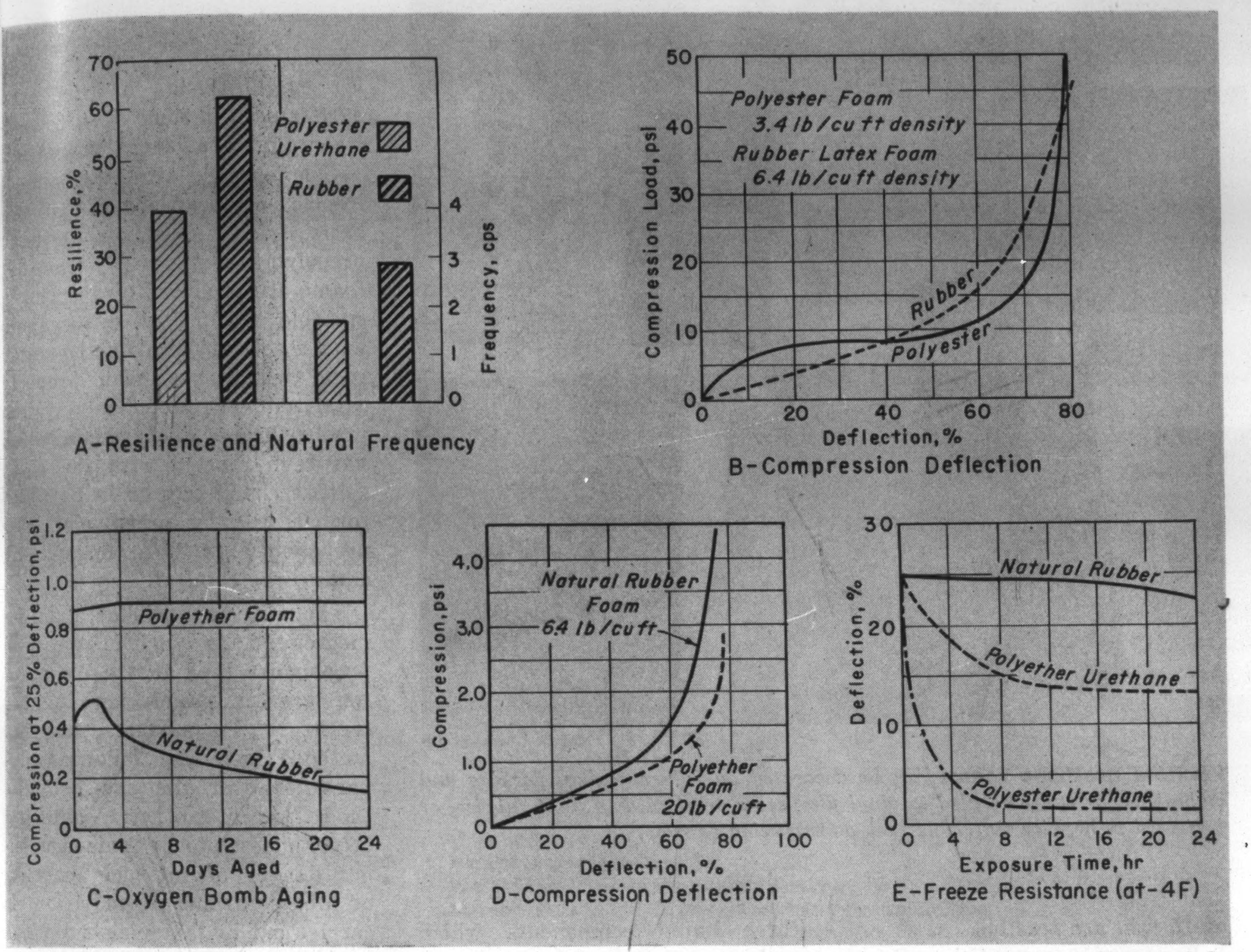
Flexible Foam Plastics

Urethanes

Urethane foams can be produced with a wide variety of properties and characteristics. Primary interest lies in the flexible types, though they can be made rigid or semi-rigid as well. (See section on Rigid, Foamed-in-Place Foams.) They can have open or closed cells. Density, which is regulated by the ingredients, can be varied from less than one to over 30 lb per cu ft.

Urethane foams are made by reacting diisocyanates with selected polyols such as polyesters, which are chain extended by reaction with water. The conversion of the polyol to a higher polymer with the simultaneous evolution of carbon dioxide gas forms the cellular material. If the original viscosity of the polyol is favorable, and if the chain extension takes place at the proper rate, the carbon dioxide gas is trapped in the gel structure. The resultant cellular structure cures to a stable solid state through the aid of a catalyst in the compound.

The character and proportion of the original ingredients determine the properties of the end foam. Long straight chain type polyols with fairly high molecular weights produce elastic, foam rubber-like products, while polyfunctional branched low molecular weight type polyols yield rigid foams. The amount of carbon dioxide released (which determines density) can be controlled by altering the amount of excess diisocyanate and water used in the formulation.



E. I. du Pont de Nemours & Co.

Fig 1 Flexible urethane foams *of the polyester and ether types are compared with each other and with foam rubber.*

Diisocyanates are very active aromatic compounds and must be handled with care in well ventilated working areas. Exposure to diisocyanate vapors should be avoided. It should be emphasized, however, that these materials can be used safely by observing manufacturers' instructions for proper handling and storage. The expanded foams are not considered to be toxic.

Flexible compositions—While flexible urethanes have been used on a fairly large scale in Germany for some time, they are still in the early production stages in this country. Formulations developed cover a broad range of flexibilities, moduli, densities, and mechanical strength. Flexible polyurethane foams are noted for their excellent physical strength, abrasion resistance, thermal insulating properties and chemical resistance. The principal interest in their use has been in cushioning applications. One of the major limitations of the flexible formulations is inability to foam them into anything but slab stock.

At present, there are two major types of flexible urethane foams. One is obtained by reacting saturated polyester resins with a diisocyanate, the other—a very recent development—is obtained by reacting diisocyanate with long chain ether glycols (Fig. 1).

Polyester-based flexible urethanes are well suited for cushioning applications such as automobile crash pads and clothing liners, but they lack certain characteristics desirable for seating and bedding applications. Deflection characteristics of the material are quite different from those of foam rubber. Urethanes are characterized by a point of inflection at about 6-10% compression, which results in a plateau effect when compressive force is applied. Other disadvantages of the material are relatively low freeze resistance and aging qualities.

Though not yet in full production, the new polyether flexible foams have shown considerably better properties than the original polyesters. Resiliency is comparable to foam rubber and the load deflection for a 2 lb per cu ft foam closely matches that of a 6 lb per cu ft latex foam. Freeze resistance, though not equal to foam rubber, is superior to that of the polyester-based urethanes. In general, the polyether foams are at least equal or superior to any of the commercially available polyester-based foams today. While polyether foams present certain processing difficulties they have been successfully molded into 7-in.-deep bus cushions and mattresses. Experiments indicate that total molding cycles on the order

Mobay Chemical Co.

Flexible urethane foams *can be decorated by silk-screening, flocking and embossing, or can be sealed to vinyl film, sewn or stapled to light fabrics, or cemented to heavier materials such as carpeting or rugs.*

of 15 min are feasible.

Semi-rigid compositions—Based on castor oil-diisocyanate reaction products, semi-rigid polyurethane foams are essentially of closed cell construction, especially at higher densities. They have excellent thermal and electrical insulation characteristics and good mechanical strength properties. Adhesion to various material is excellent, and tough foams can be produced at room temperature in a matter of minutes, in densities generally ranging from 2-25 lb per cu ft (see Table 1).

The principal fields of application of this type of foam are where characteristics such as thermal insulation are of prime importance, and where service temperature ranges are not too high. Promising uses include railroad car insulation, field installed pipe and equipment insulation, and acoustical insulation, particularly for the lower density foams.

Forming and fabrication—Formulations consist of two or three liquid components which must be mixed in definite proportions at room temperature. Mixing is generally carried out on or near the point of application. Though hand mixing can be employed successfully for small batches, special mixing equipment must be used for larger amounts. Conventional mixing equipment causes problems because of the high reaction speeds involved. Expanded structures are generally air cured, though a brief oven cure is used in some cases to realize optimum strength properties.

Commercially available foamed-in-place compositions are of two basic types: one-shot, and the prepolymer systems. One-shot foams are produced by reacting a suitable amount of diisocyanate with a selected alkyd or polyester resin which has been properly catalyzed. The prepolymer system involves use of diisocyanate which has been reacted with the resin (either completely or in part) to form a so-called prepolymer. The prepolymer is then foamed by adding the catalyst.

Though the one-shot foaming method is the older of the two, prepolymer type foams are gaining greater prominence in this country. Prepolymer foaming methods have the following advantages over the one-shot method: lower exotherm, allowing larger masses to be foamed without danger of internal charring or discoloration; formulation is carried out by materials suppliers who can usually do it more efficiently; better uniformity of product and reproducibility of results; and greater flexibility of formulation. On the other hand, prepolymers cannot be prepared with every alkyd-isocyanate combination. Certain formulations, designed to provide special properties such as high heat resis-

How plastics are expanded

1. Gas expansion—Gas can be used to form the expanded material by a) introducing gas under pressure directly into a soft plastic mass; b) incorporating under pressure a low boiling point solvent, which volatilizes when the pressure is released at a temperature above the solvent's boiling point; c) aeration or frothing of the soft plastic mass; d) incorporating a chemical or group of chemicals which when heated decompose, releasing gas; and e) reacting chemicals in the formulation which during polymerization release a gas.

2. Soluble solids—A soluble solid material can be incorporated in the soft plastic mass. After the mass has been formed, the material is leached out by solvents.

3. Filler—A bulky filler can be incorporated in a binding resin. Partial fusion of the mass produces a porous material.

4. Bonding fibers—Loose fibrous structures can be bonded with resinous materials to form lightweight porous masses.

tance or maximum strength and dimensional stability can best be furnished in one-shot type compositions.

Vinyls

Vinyl foams can be produced with either open or closed cell structures, in either flexible, rigid or intermediate forms. Primary interest today is in the flexible materials. They can be foamed in a variety of shapes and, since they are thermoplastic materials, can be heat-sealed readily. Thus, they can be joined simply to vinyl or other types of films to produce a wide variety of decorative or functional items. Density can be varied from about 5 to 30 lb per cu ft.

Vinyl foams have outstanding resistance to ozone, moisture, mildew and rot. They are resistant to a variety of chemicals, though they are attacked by ketones and similar solvents. Over 95% of all vinyl foam made today is said to be self-extinguishing.

Since vinyl foams are thermoplastic materials they gradually become softer as temperatures increase, and stiffer as temperatures decrease. Maximum and minimum service temperatures depend on formulation, design of part and service condition. In general, temperature range through which vinyl foam can be used continuously is 20 to 150 F. Foams can be used intermittently at both higher and lower temperatures. Typical properties are shown in Table 2.

The base materials for vinyl foams are plastisols consisting of a vinyl dispersion resin, a plasticizer system, stabilizers, fillers and colorants. There are two different methods of foaming the material. One uses chemical blowing agents which decompose at specific temperature levels to yield a gas, usually nitrogen, which in turn expands the heated plastics mass. The second process (licensed by Elastomer Chemical Corp.) involves mechanically mixing an inert gas into a vinyl compound under pressure and discharging the mass into suitable

TABLE 1—PROPERTIES OF SEMI-RIGID URETHANE FOAMS[a]

Density, lb per cu ft	1	2	4	6	8	10	12	16	20
Yld str (0.2% offset), psi	2.5	4	20	50	75	—	200	—	—
Comp str (50% deflection), psi	5	9	48	78	150	200	380	—	—
Thermal expansion, (−22 to 86 F), 10^{-5} in./in./F	—	1.4	—	—	—	—	—	5	—
Thermal insulation, K	0.20	0.20	0.21	0.22	0.23	—	0.26	0.28	0.30
Water absorption, lb/cu ft of foam									
25 day soak	28	24	22.8	—	—	—	—	4	2
120 hr at 50% RH	0.005	0.006	0.027	—	—	—	—	0.067	0.084
120 hr at 98% RH	0.38	0.38	0.39	—	—	—	—	0.359	0.560
Dielectric constant, at 10^3 cps	—	2.2	2.3	—	—	2.5	—	2.7	2.85
Resistivity, 10^{14} ohm-cm	—	6.8	6.9	—	—	7.2	—	7.7	8.3
Sound absorption coef,									
at 250 cps	—	0.73	—	0.20	—	0.22	—	—	—
at 500 cps	—	0.33	—	0.22	—	0.21	—	—	—
at 1000 cps	—	0.37	—	0.20	—	0.31	—	—	—
Bond str, psi									
to aluminum	6	10	27	—	—	56	—	—	158
to glass	5	9	25	—	—	50	—	—	142
to steel	7	12	29	—	—	62	—	—	146
to wood	8	17	29	—	—	62	—	—	170

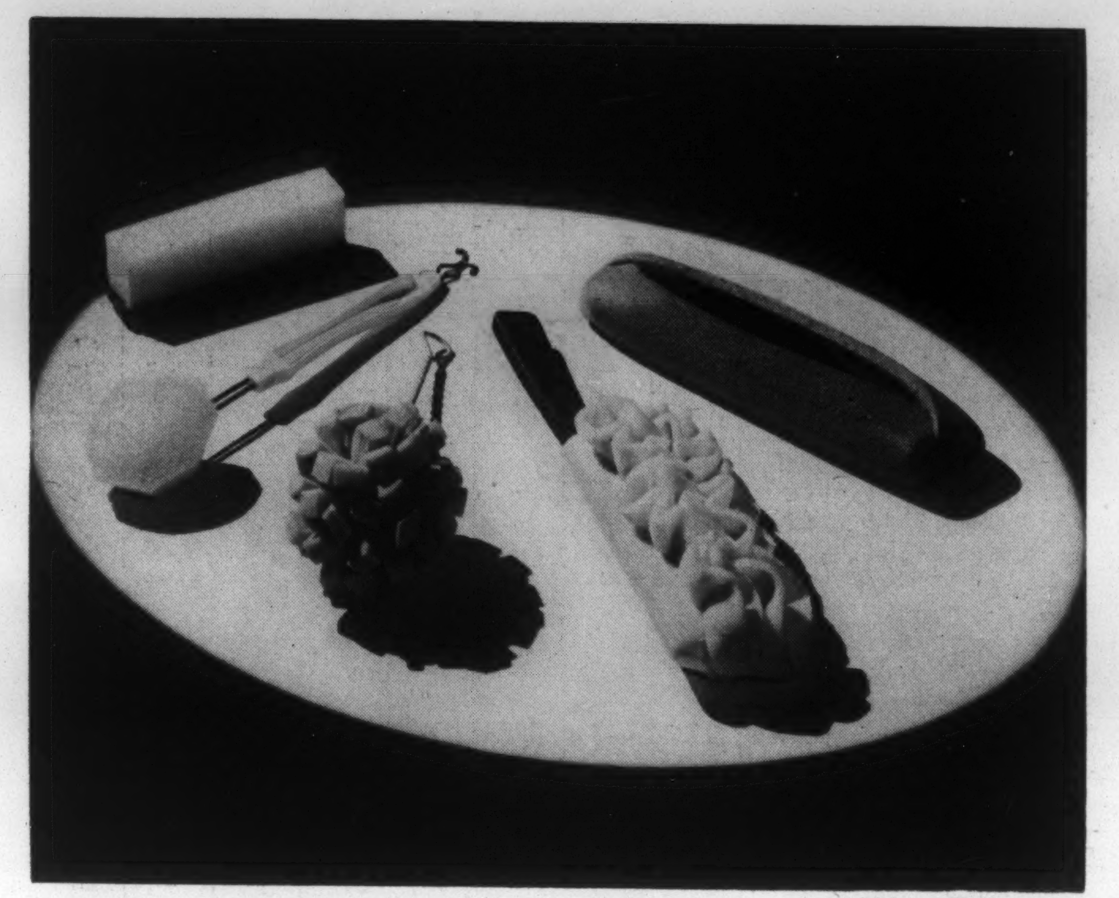
Flame resistance (Fed. Bldg. Spec. SSA118A)	
at 2 lb/cu ft	Incombustible
at 10 lb/cu ft	Self-extinguishing
Max operating temp (no load), F	200
Heat distortion/(5 psi flexure, 0.01 in. deflection), F	130
Chemical resistance	Slight swelling in many chemical solutions. Attacked by strong acids and alkalies.

[a] Pelron No. 3602, Pelron Corp.

TABLE 2—GENERAL CHARACTERISTICS OF FLEXIBLE VINYL FOAMS (OPEN CELL)

Density, lb/cu ft	4 and up
Heat sealability	Excellent
Tensile strength, psi	10 to 200
Elongation, %	75 to 300
Flammability	Self-extinguishing
Indentation load deflection,[a] lb/50 sq in. at 25% def	3 to 500
Air oven aging (22 hr at 212 F),[a] % Change from orig. ind-load-def	±20
Compression set (2 hr at 158 F),[a] Max % based on original height	15
Dynamic flexing (250,000 cycles),[a] Max % set based on original height	10
Resistance ratings:	
Strong acids	E
Strong alkalies	E
Grease and oils	G
Organic solvents	P to E
Water	E
High relative humidity	E
Sunlight	G

[a] SPI Tentative Specifications and Methods of Test for Vinyl Foams.



Mobay Chemical Co.

Household utility items *have proven the versatility and adaptability of flexible urethane foams for other uses.*

Bakelite Co.

Cellular polyethylene *is combined with conventional polyethylene in insulating this TV lead-in wire. Developed by Belden, the chord is designed particularly for high frequency transmission.*

molds or conveyors for heating and cooling.

Chemically blown foam—By foaming with chemical blowing agents in a mold under pressure and heat, a closed cell vinyl foam is produced, which has found primary applications in insulation and flotation equipment. Vinyl foams made with chemical blowing agents without the use of pressure are generally of the open cell type. A layer of a suitably compounded plastisol is poured into an open face mold or onto a web and cured with heat. Plasticizers have sufficient solvating power to hold the resin particles in suspension at room temperature, yet they dissolve the resin particles at elevated temperatures (about 330 F). The optimum plasticizer system is determined by the solvating characteristics of the resin.

One of the most important determinants of the density of this type of foam is the amount of blowing agent added. In general, densities commercially obtainable with atmospherically blown vinyl foam range from 6 to over 20 lb per cu ft.

The advantages of open cell vinyl foam products include extreme versatility in properties, ranging from soft, foam rubber-like materials with rapid elastic recovery, to more rigid shock-absorbing compositions. Also, such properties as low temperature flexibility, hardness, flame resistance, and elastic behavior can be varied as desired.

Direct gas blown foam—Elastomer's process for producing open cell Vinylfoam by mechanically mixing inert gas into the plastisol, appears to offer several advantages over chemical blowing processes. These include: 1) greater uniformity of product; 2) wider range of densities (5-30 lb per cu ft); 3) better compression set characteristics; and 4) less expensive foam since expensive blowing agents are not used, and the process is continuous rather than batch type. It is estimated that as much as 90% of all flexible open cell type vinyl foam is made by the Elastomer Process.

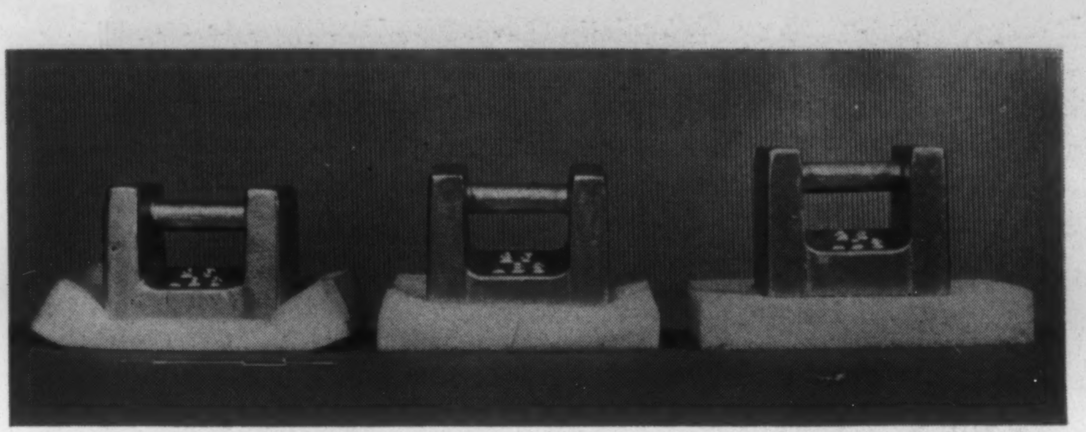
At present, Vinylfoam falls close to latex in permanent set characteristics, provided a 2-hr recovery period is allowed at test temperatures. Maximum recommended continuous service temperatures under loads range from 130-160 F. A considerable amount of work is now being carried out to improve the heat resistance and low temperature flexibility of Vinylfoam. The material is not recommended for flotation because of its open cell structure.

Perhaps the biggest potential for Vinylfoam lies in applications where its ability to be heat sealed as well as its ability to be foamed in composite structures are of paramount importance. It is currently being used in applications such as automobile upholstery; clothing and furniture padding; industrial gaskets, rollers, filters and shock mountings; toys; in laminated structures; and in railroad and other transportation and institutional seating applications.

Polyethylene

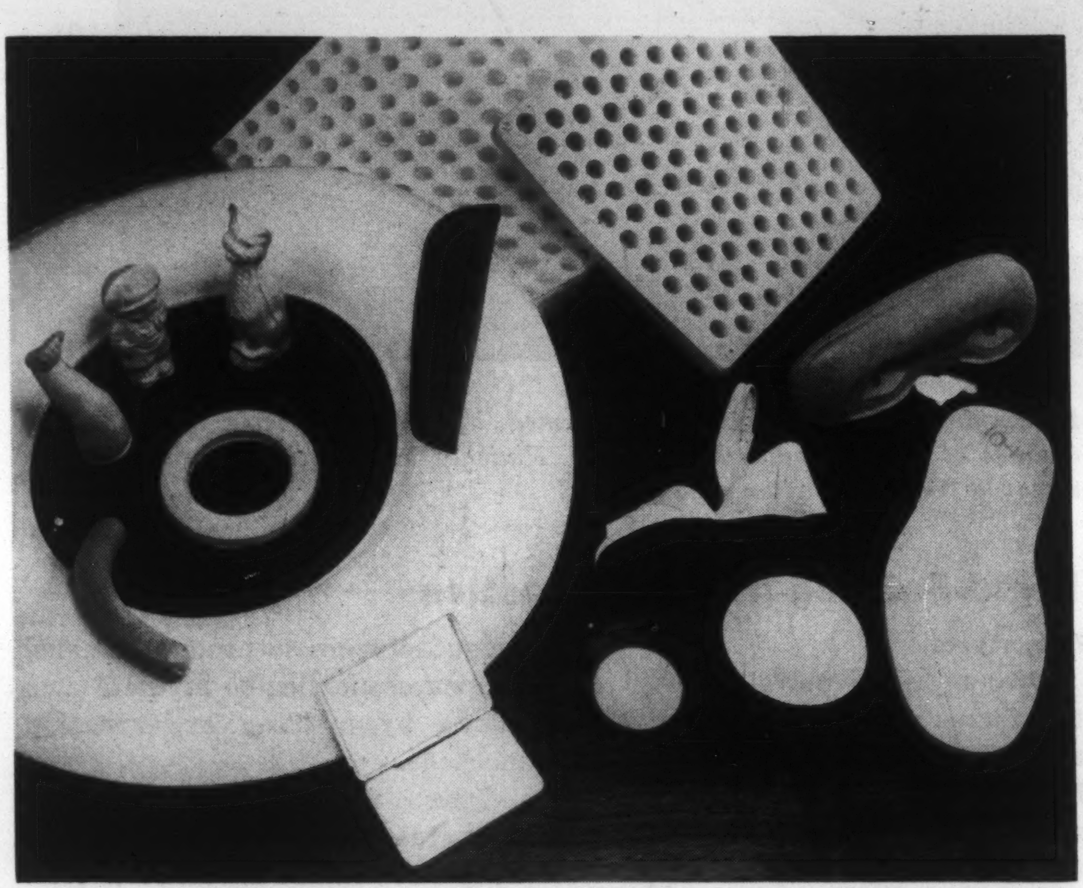
Cellular polyethylene (Bakelite Co.) has most of the basic properties of conventional polyethylene, such as chemical resistance, toughness, flexibility, and low moisture absorption. It has even higher electrical insulating qualities and is lighter in weight. Its primary use would seem to be as wire insulation. It is produced by dispersing a chemical blowing agent in the resin and subsequently heating to liberate gas which forms the closed cells. The material has been found to be of particular importance for electronic applications. Table 3 compares properties of cellular polyethylene with those of conventional low density polyethylene.

Cellular polyethylene is said to be particularly useful where lower electrical attenuation and line losses at high frequencies are needed, and where insulation weight is a problem. It has been successfully extruded into rods and sheets. It has also shown promise in gasketing and cap and closure lining applications.



Elastomer Chemical Corp.

Flexible vinyl foams *produced by the Elastomer Process can have differing compression-deflection characteristics. All three foams have densities of 4.5 lb/cu ft, but they range from soft to firm (left to right).*



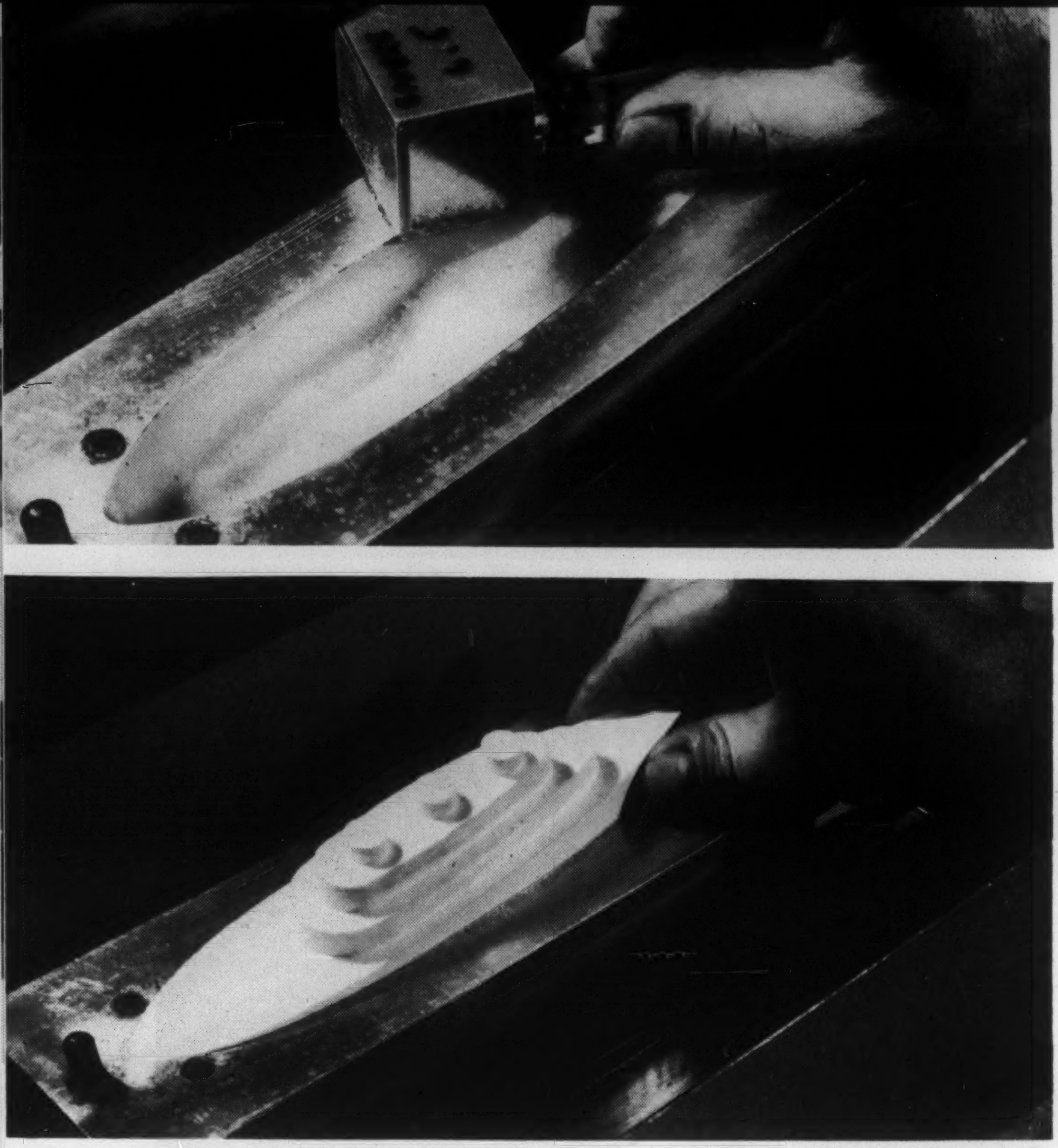
Foam King, Inc.

Chemically blown vinyl foams *can be produced in a variety of shapes, with both open or closed cell structure.*

TABLE 3—PROPERTIES OF CELLULAR POLYETHYLENE[a]
(WIRE INSULATION)

	Solid polyethylene	Cellular polyethylene
Wire size No. 14AWG Insul. o.d. in.	0.250	0.250
Tensile strength, psi	2180	670
Elongation, %	580	310
Spec gravity	0.92	0.47
Diel. str, ASTM short time test (0.125 in.), v/mil	630	220
ASTM long time test (0.125 in.), v/mil	590	190
Power factor, 1000 cycles	0.00028	0.00033
10,000 cycles	0.00030	0.00038
Diel. constant 1000 cycles	2.3	1.48
10,000 cycles	2.3	1.49

[a] Bakelite Co., A Div. of Union Carbide and Carbon Corp.



Koppers Co.

***Foamed polystyrene boat** is formed by charging mold with amount of Dylite beads shown above. Finished boat is shown being removed from mold after expansion.*

Rigid Foamed-in-Place Plastics

Polystyrene

Two types of polystyrene plastics foams are commercially available. Dylite (Koppers Co.) can be foamed in place to fill any shape cavity, while Styrofoam (Dow Chemical Co.) is supplied as planks or boards of foam which can be cut and fabricated. Styrofoam will be discussed in the section devoted to rigid prefoamed materials.

Dylite is supplied in the form of colorless or colored beads. By heating in a suitable mold the beads expand, crush together and fuse into a strong, light weight foam with discrete closed cells. Beads can be expanded up to thirty times their original volume. Density of resulting foams is controlled by the amount of beads charged into the mold and can be varied from 1.5 to 15 lb per cu ft. A major advantage of the material lies in the simplicity of the foaming process, permitting small manufacturers to produce foamed shapes economically in their own plants by molding or extrusion methods.

These foams can be used at temperatures up to about 170 F. They have high resistance to passage of heat (thermal conductivity of 2.5 lb per cu ft density foams at 75 F is 0.243 Btu/hr/sq ft/F/in.), low water absorption, low water vapor permeability, and they are odorless and resistant to fungi. All molded foam pieces come from the mold with a dense, hard, smooth skin which enhances strength properties. Typical properties of Dylite are shown in Fig 2 and Tables 4-A, 4-B, and 5.

Forming and fabrication—The basic requirements for foaming Dylite are a source of heat and a suitable mold. Temperatures needed for expansion are 230-270 F. Steam pressures range from 10-30 psi. Three methods have been developed for expansion: 1) direct introduction of dry steam into the mold cavity; 2) steam-heated molds; and 3) molds heated by hot air. The method selected depends largely on the thickness of the part to be molded. Direct introduction of steam is recommended where section thickness is greater than one inch. Choice between steam- or air-heated molds is dependent on individual plant facilities.

Design and fabrication of molds depends on such factors as density, which determines the pressures developed during expansion; size and shape; and quantity of production. The most suitable materials for mold construction are aluminum and copper alloys. Brass has been found to give maximum ease of mold parting, provided suitable draft has been provided. Wall thickness of molds should be at least ¼ in. since internal pressures due to expansion may rise as high as 50 psi.

Expansion cycles when using direct steam expansion may be as short as 10 sec for small pieces or up to 3 min for 12-in.-thick sections. Molds heated externally by steam or hot air require 10 min cycles for sections about ½ in. thick. For one-inch-thick sections 20-min cycles are necessary. Cooling time after expansion varies from 30 sec for small parts to 10-15 min for 12-in.-thick pieces. Shock cooling must be avoided because of the danger of excessive shrinkage and warpage.

Extrusion has also proved to be a satisfactory method of expanding Dylite polystyrene beads. It is particularly successful for shapes such as sheet, rod, and tube. Extruders range in size up to 4½ in. in dia. Barrel temperatures are 250-275 F and die temperatures range between 250 and 320 F. Feed zone temperatures should be between 160-190 F. Forming dies for shaping the expanding foam can be placed so that the material feeds into them as it leaves the die lips.

To form difficult pieces (thick sections or irregular shapes) with densities of less than 2 lb per cu ft, partially expanded beads can be charged into the mold. Pre-expansion is accomplished by exposing the beads to dry heat prior to charging them into the mold.

Polystyrene foam can be bonded successfully to itself and a variety of other materials with a number of commercially available adhesives. Adhesives containing appreciable amounts of solvents for polystyrene should be avoided.

The foam can be fabricated after curing by sawing, planing and other shaping operations commonly used for wood fabrication. It can also be shaped by means of an electrical resistance wire. Higher density materials cut slower than lower density materials.

Decorative and protective coatings can be applied readily. Both glossy and egg shell finishes can be obtained. Water-base paints or alcohol solutions of dyes, as well as latex emulsion paints may be used. Coatings must not contain substantial amounts of solvents for polystyrene. Protective coatings improve weathering, flame resistance and abrasion resistance.

Urethanes

As mentioned before, urethane foams can be produced in rigid, semi-rigid or flexible form. Flexible and semi-rigid urethane foams are discussed in the section on flexible foams. Formulation and fabrication data for the various types of urethanes are also included there.

Rigid urethane foams can be produced with densities ranging from less than one to 35 lb per cu ft. They are primarily of closed cell structure, though open cell formulations have been developed. Cell size can be varied. The rigid foams, formed by reacting polyisocyanates with resinous polymers such as alkyds can be foamed-in-place to fill any shaped cavity at atmospheric pressure without additional heat.

Physical strength, of course, is greatly influenced by density. In general, rigid polyurethanes have excellent strength-to-weight ratios, and exceptional adhesion to

TABLE 4a—TYPICAL MECHANICAL PROPERTIES OF FOAMED-IN-PLACE POLYSTYRENE[a]

Density, lb/cu ft	2	3	4	6	8	10
Tensile str, psi	30-50	55-75	65-85	90-110	110-120	120-130
Compressive str (5% off-set), psi	15-20	25-35	40-50	60-70	70-80	90-100
Flexural str, psi	Flexible	60-90	90-120	130-160	200-230	280-310
Impact str, in.-lb/in. unnotched (1 in. wide specimen)	2.0-2.5	2.3-2.8	2.5-3.0	3.0-3.5	4.3-4.8	5.0-5.5

[a] Dylite, Koppers Co.

Test specimen size varied as necessary.

All tests conducted at 73 F.

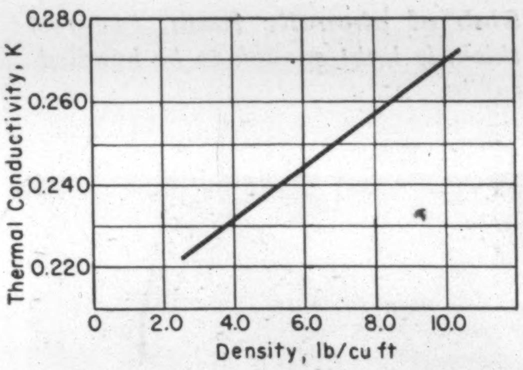
TABLE 4b—BUOYANCY CHARACTERISTICS OF FOAMED-IN-PLACE POLYSTYRENE[a]

(Expressed in Lb for 1 Cu Ft)

Density, lb/cu ft.	Initial Fresh Water D=62.4 lb/cu ft.	Reserve[b] Buoyancy (Fresh Water)
2	60.4	60.3
3	59.4	59.3
4	58.4	58.3
5	57.4	57.3
6	56.4	56.3
7	55.4	55.3
8	54.4	54.3
9	53.4	53.5
10	52.4	52.3

[a] Dylite, Koppers Co.

[b] After maximum water absorption of 0.0156 lb per sq ft surface area.



Koppers Co.

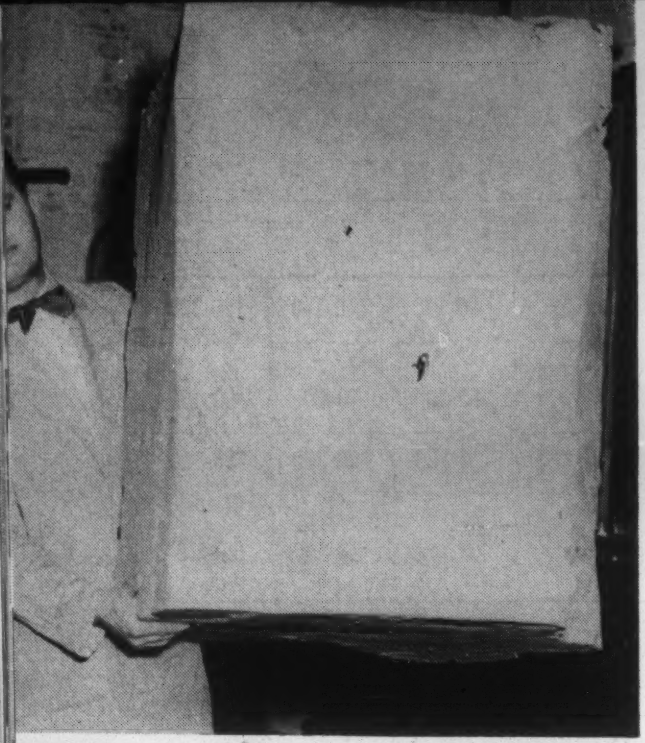
***Fig 2* Thermal conductivity** *of Dylite foamed-in-place polystyrene increases with density.*

TABLE 5—ELECTRICAL PROPERTIES OF FOAMED-IN-PLACE POLYSTYRENE[a]

Dissipation factor	<0.0005
Loss factor	<0.0006
Volume resistivity 10^7, megohm-in.	>1.5
Surface resistivity 10^6, megohms	>9.8
Dielectric strength, v/mil	
Short time	48
Step by step	49
Dielectric constant	
at 73 F, 50% R.H.	
60 cps	1.19
1000 cps	1.07
1,000,000 cps	1.02
after 48 hr at 122 F	
60 cps	1.24
1000 cps	1.06
1,000,000 cps	1.05
after 96 hr at 95 F, 96% R.H.	
60 cps	1.24
1000 cps	1.05
1,000,000 cps	1.05

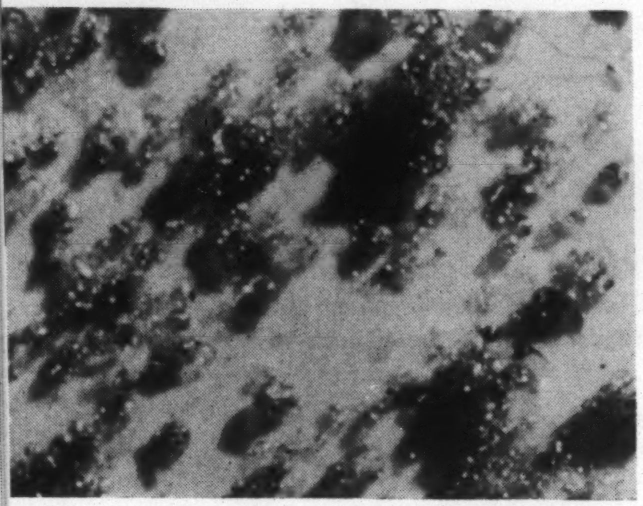
Note: No arc resistance. Melts at first spark.

[a] Dylite, Koppers Co.



General Electric Co.

***Slab of phenolic foam,** two feet thick, is light enough to be handled easily.*



Bakelite Co.

***Syntactic foams** can be made by filling conventional casting resins with these tiny phenolic microballoons. Microballons vary in diameter from 0.002 to 0.0036 in.*

wood, primed metal, fabrics and other materials. They have good moisture resistance, unusually high electrical insulating qualities, oil and fungus resistance, and remarkable thermal stability if desired. They can be drilled, sawed, milled and sanded. The foams are not friable and can be colored to suit any specific set of requirements. Typical properties are shown in Fig. 3.

Rigid polyurethanes are being used in aircraft as structural reinforcement against shock and vibration, as well as for thermal and electrical insulation. They are being used in increasing quantities in sandwich materials. They are also finding use as flotation gear in boats, life rafts, navigation buoys and emergency marine equipment. Limited uses have been developed for packaging fragile electronic equipment. As structural reinforcement, the foam is being used in fabrication of engine cowlings, as cores for ailerons, rudders, elevators and wing tabs.

Phenolics

Phenolic foams are composed of 40% open and 60% closed cells. Density varies between less than one to more than 25 lb per cu ft. Cured expanded structures are inherently brittle with high density surfaces which serve as protective skins. Most of the properties of expanded phenolic resin structures are quite similar to those of the parent resin. Typical mechanical properties are shown in Table 6. Low water absorption characteristics can be obtained by applying suitable protective coatings.

TABLE 6—PHYSICAL PROPERTIES OF PHENOLIC FOAM[a]

Density, lb/cu ft	2-5[b]	7-10
Comp str, psi	9-31	45-130
Tens str, psi	4-35	35-75
Flex str, psi	24-40	75-230
Shear str, psi	8-30	40-135
Moisture absorption, % by weight		
at 100% R.H.	13-51	10-51
at 50% R.H.	1-4	1-5
at 20% R.H.	½-1	1-2

Heat resistance (intermittent), F—Up to 550 (5-lb density)
Flammability —Will not support combustion
Adhesion —Good to wood, paper and metal properly undercoated
Shrinkage from mold —Approx. 1/32 in./ft
Cell structure —Mostly disconnected
Corrosiveness —Slight hydrochloric acid reaction

[a] Based on data supplied by General Electric Co., Rezolin, Inc.

[b] Density range most common for "foamed-in-place" applications.

Phenolic foams have excellent thermal and acoustical values (See Tables 7 and 8.). Optimum thermal insulation properties are obtained with densities of about 1 lb per cu ft. Phenolic foams have practically the same degree of heat and chemical resistance as unexpanded phenolic resins. They can be used for continuous service at temperatures up to about 300 F. They are self-extinguishing, and have excellent chemical resistance, with the exception of certain alkalies, alcohols and ketones.

Principal applications for phenolic foams include buoyancy products, thermal insulation, packaging and core materials. Their use as acoustical insulation has not been developed as yet in spite of the fact that they are among the best sound absorption media available, while at the same time economical. Phenolic foam as a buoyancy material has had several large scale uses. The Navy in particular has expressed considerable interest in field applications.

Packaging applications are a promising development, although this field has not yet realized the market originally anticipated. The use of ⅓ to ½ lb per cu ft foam presents an important advantage from the standpoint of dunnage. Advantages over conventional packaging materials include low weight per unit of volume, less packing time, less product breakage, and less worker fatigue. Good thermal insulating characteristics are an added advantage in some applications.

Thermal insulating qualities of the material are currently being applied by using phenolic foams as honeycomb components in sandwich construction. Phenolic foams have also been found to offer sufficient strength, combined with light weight for use as core materials in plastics dies and fixtures.

Forming and fabrication—Phenolic expanded plastics are generally produced from liquid phenolic resins by a chemical blowing process in which liquid resins are expanded up to 300 times their original volume. The formulation usually consists of the resin, curing agents or accelerators and blowing agents. The accelerators, usually acid in character, generate exothermic reactions the heat from which activates the blowing agents, liberating gas. Additional ingredients are often added to control density, cell size, etc. Air can be beaten into the resin prior to addition of the curing agent in order to provide seeding nuclei for the expansion process, and to improve the resiliency of the foamed structures. The entire foaming process can be completed in as little as 2-3 minutes without application of either external heat or pressures.

TABLE 7—SOUND ABSORPTION OF PHENOLIC FOAM[a]

Frequency range, cps	Transmission loss, decibels	Frequency range, cps	Transmission loss, decibels
100	12.5	2500	28.5
200	17.5	3000	17.0
500	11.0	3500	13.5
1000	19.5	4000	9.5
1500	18.5	5000	2.5
2000	13.0	—	—

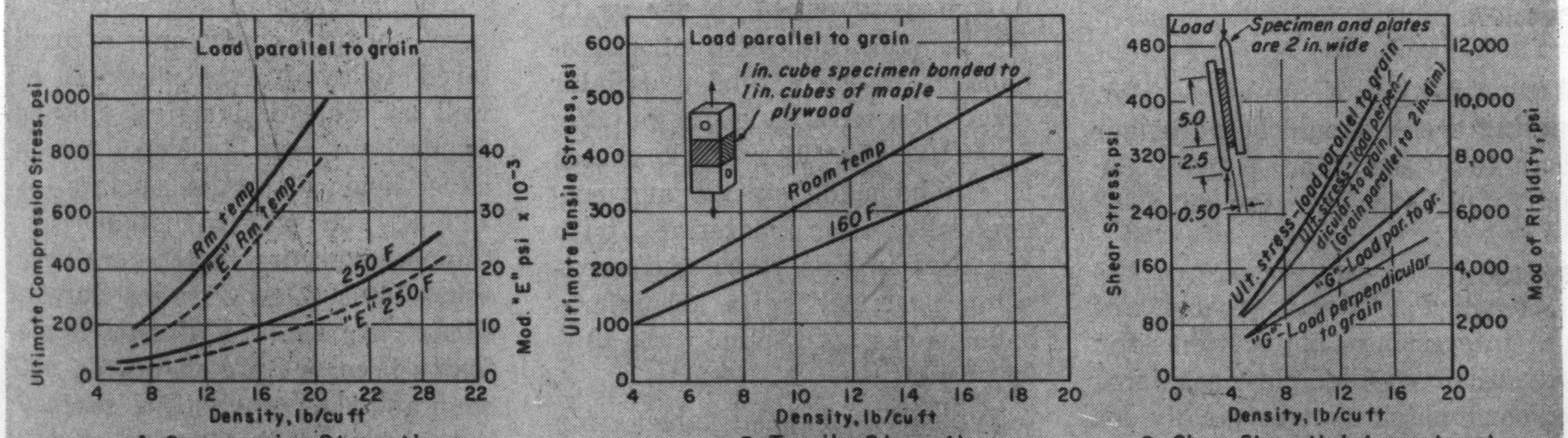
Average transmission loss over entire range = 14.8 decibels.

[a] Nelson, J. D., *Phenolic Foams*, SPE Journal.

TABLE 8—COMPARATIVE THERMAL CONDUCTIVITY OF PHENOLIC FOAM[a]

Material	Density, lb/cu ft	Mean temp, F	Conductivity, Btu/in./F/sq ft/hr
Phenolic foam	1.7	73.7	0.24
Phenolic foam	7.9	72.7	0.28
Corrugated paper	1.9	75.0	0.26
Glass wool	2.3	75.0	0.26
Cork board	7.0	75.0	0.28
Rock wool	6.0	75.0	0.26
Rock wool	2.0	75.0	0.27
Fibre board	12.0	75.0	0.31
Fibre board	18.0	75.0	0.34
Hair felt	9.0	75.0	0.26

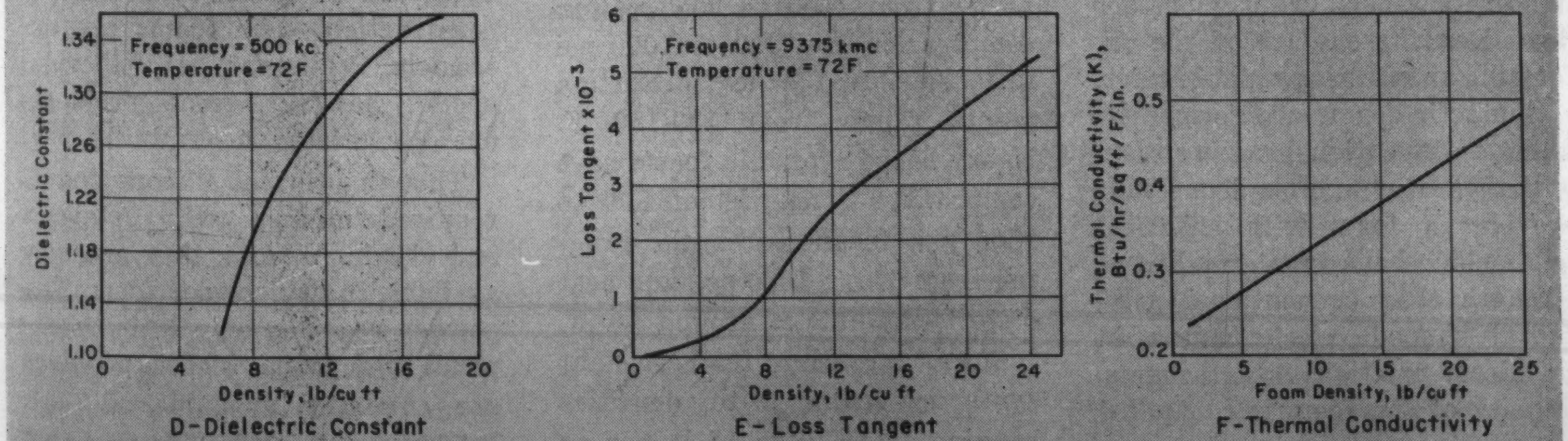
Nelson, J. D., *Phenolic Foams*, SPE Journal.



A-Compression Strength

B-Tensile Strength

C-Shear Strength (at room temp)



D-Dielectric Constant

E-Loss Tangent

F-Thermal Conductivity

Nopco Chemical Co.

Fig 3 Rigid urethane foams *can be foamed in place. Properties shown cover two Lockfoam series.*

Dow Corning Corp.

***Foamed silicone resins** can be heated cherry red on one side, while the other side remains cool enough to touch.*

After addition of the accelerator, mixing cycles should be no longer than 10-30 sec before pouring the activated batch into the mold.

Syntactic

So-called syntactic foams are an interesting application for tiny, nitrogen filled plastics microballoons which were originally developed to reduce oil evaporation in storage tanks. The balloons are floated on the surface of the oil, forming an effective vapor barrier.

Syntactic foams are formed by filling a conventional casting resin with these tiny microballoons. This provides a foam with spherical cells, which have greater inherent strength than conventional polyhedral shaped cells common in chemical reaction type foams. Density of the foam is controlled by altering the ratio of microballoons to casting resin.

Two types are currently available. The first consists of microscopic phenolic spheres (Bakelite), the second uses microscopic urea spheres (Colton Chemical). These spheres can be used to fill polyester, epoxy and other selected casting resins.

Principal applications for the material are in sandwich construction, fillers for castings, and low density aggregates. Techniques have been developed which permit in one operation the manufacture of sandwich materials consisting of glass-reinforced laminate faces with syntactic foam cores. Other potential uses include airplane wing structures, plastics boats, gun stocks, air conditioning units and refrigerator cores. Work has been carried out which suggests that the combination of strength and controlled light-weight would be of immediate benefit in wall boards, floor covering and ceiling tiles.

Phenolic microballoons—Forming requirements consist of equipment and molds used for molding conventional casting resins. Bakelite's phenolic microballoons have an average particle diameter of 0.0013 in. and exhibit an apparent bulk density of 8.7 lb per cu ft. By varying the ratio of microballoons to resin binder, cellular structures with densities ranging from less than 20 to 40 lb per cu ft can be made quickly and economically. For materials with densities in this range the maximum practical ratio of microballoons has been found to be 40% by weight.

Typical strength values for polyester bound syntactic foams range from 1000 to 3000 psi in compression and 300 to 1000 psi in tension. ASTM heat distortion points range from 130-180 F. Epoxy based syntactic foams have compressive strengths of 800 to 1500 psi, tensile strengths ranging from 600 to 1000 psi, and heat distortion points of around 140 F.

More recently, featherweight syntactic foams with densities ranging from 10 to 15 lb per cu ft have been developed. These make use of a dry powdered phenolic resin as a bonding agent for the microballoons, and density of the resultant cellular structure depends on how tightly the mold is packed. Typical mixes of this type consist of 40 parts by weight of phenolic resin and 60 parts by weight of microballoons. These compositions flow like fine sand and are poured into a suitable mold where they are cured for 2 hr at 250 F. These so-called featherweight foams have compressive strengths varying from 225-300 psi.

Urea microballoons—Colton Chemical's urea-formaldehyde microballoons are white in color, and have an average particle size of 16 microns, with a bulk density of 3.7 lb per cu ft. Amounts of the microballoons which can be added to polyester, epoxy, or phenolic bonding resins range up to 45% by weight of the finished material. Resultant foams have flexural strengths ranging from 1000 to 3000 psi and compressive strengths ranging up to 11,000 psi, depending on the ratio of microballoons to binder.

Silicones

To meet the higher temperature service conditions encountered today in the aircraft as well as other industries, silicone foams have been developed which have heat distortion points of 700 F, and will withstand continuous exposure to temperatures above 700 F (Dow Corning Corp.). When exposed to direct flame foams become red hot, but do not burn and show only slight surface change. Properly foamed structures are of closed spherical cell construction. The foams are extremely resistant to thermal shock; however, some problems are encountered in friability.

Though original silicone foams required mixing with catalysts and blowing agents, they are now available in dry powder form. The powder requires only heat to expand into foam. Three powders are currently available, R-7001, R-7002 and R-7003. The first two can be foamed in place. The latter can be foamed only in block or sheet form. It is stronger and

TABLE 9—PROPERTIES OF SILICONE FOAMS[a]
(OPEN PAN FORMED)

	R-7001	R-7002	R-7003
Expansion temp, F	320	320	320
Density, lb/cu ft	12	14	16
All size, dia	<0.08	<0.08	<0.08
Compressive strength, psi	100	200	325
at 77 F after 200 hr at 500 F	100	190	210
at 500 F, after ½ hr at 500 F	5	25	70
at 500 F, after 200 hr at 500 F	20	45	80
Weight loss, % during expansion	1.2	1.3	1.0
after 1000 hr at 500 F	3.5	2.6	2.6
after 1000 hr at 570 F	8.0	4.2	4.2
after 72 hr at 700 F	8.5	5.2	5.2
Water absorption (24 hr immersion), %	3.2	2.3	2.1
Heat distortion, F	>700	>700	>700
Flame resistance		do not burn	
Dielectric constant, 10^5 cycles	1.23	1.25	1.26
Power factor, 10^5 cycles	0.0004	0.00102	0.00105
Thermal conductivity, Btu/hr/sq ft/F/in.	0.3	0.3	0.3

[a] Dow Corning Corp.

retains more high temperature compressive strength than the other two. Table 9 lists typical properties of the foams.

Applications for the foams include thermal and electrical insulation in missiles and high speed aircraft, as well as in specialized electronic equipment. Their low density and low water absorption suggest uses as buoyant components for ships and boats.

Forming and fabrication—Silicone foams can be cut or carved or machined to close tolerances by conventional wood-working tools. When foamed in place they adhere to most metals and glass cloth laminates. For maximum adherence to cavity walls, the walls should be primed with a silicone resin.

To produce the foams, the dry powder is charged in a suitable mold and heat is applied. Heat may be supplied by air circulating ovens, strip heaters, heat lamps or similar equipment. To insure against shrinkage, the structure should be exposed to the expansion temperature for an additional 4 hr. The foam may then be removed or the temperature raised for post-curing. Though post-curing is not essential in all applications, where maximum mechanical properties are required at elevated temperatures, a cure of about 48 hr at 480 F is recommended.

Rigid Prefoamed Plastics

Polystyrene

Rigid, prefoamed polystyrene, available in board or rough plank form, is of closed cell construction and can be purchased in densities ranging from 1.3-2 lb per cu ft. Called Styrofoam (Dow Chemical Co.) the material is extremely light in weight with relatively good strength properties, which vary with density as shown in Table 10. The foam appears white because of the refraction and reflection of light by its multitude of cell walls. (Foamed-in-place polystyrene, Dylite, is described in another section.)

The insulating properties of Styrofoam are excellent. The K factor compares favorably with those of other commercially available board insulating materials. Exact value of thermal conductivity depends on cell size and increases with larger cell size. This is probably due to a reduction in the amount of heat transferred by convection and radiation. Maximum service temperature for continuous operation is 175 F.

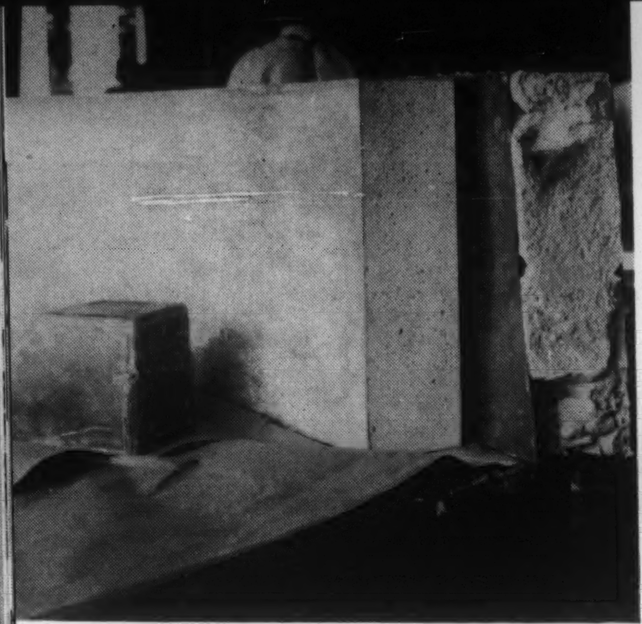
Because of its closed cell structure, the material's water resistance is excellent. Its water vapor transmission is exceptionally low and the foam will not rot or support mold growth. The non-toxic material has chemical resistance similar to that of conventional polystyrene, and it will not deteriorate after prolonged contact with water. Styrofoam does not have particularly good acoustical insulation properties. Surface cells, though broken, are non-interconnecting and reflect rather than absorb sound waves. In general, the material is comparable to wood in sound absorption. Dielectric characteristics of the material are excellent. Dielectric constant is less than 1.0 with a power factor of less than 0.0002 over a frequency range of 10^2 to 10^8 cps.

Principal disadvantage of foam polystyrene is its flammability; however, a formulation has been developed which is self-extinguishing. On contact with flame it melts without bursting in flames.

Styrofoam has been found to be well suited for use in insulating storage and freezer spaces of all types, including stationary rooms as well as moving equipment such as railroad cars, truck and trailer bodies, and ships. Still another promising field is the insulation of pipes, ductwork, tanks and other industrial processing equipment.

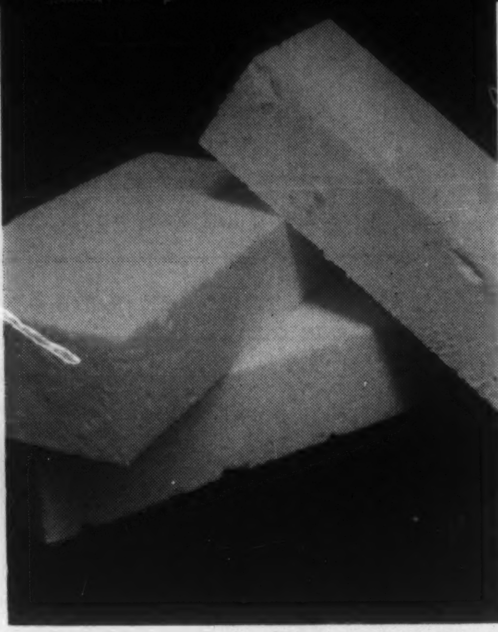
Buoyancy characteristics of the material have made it acceptable for such applications as the replacement of air-tight chambers in many types of marine craft, buoys and flotation gear, swimming rafts and floating docks.

Styrofoam is now considered a basic material in the floral, display and novelty fields. Major use in the floral trade is as a foundation for floral pieces.



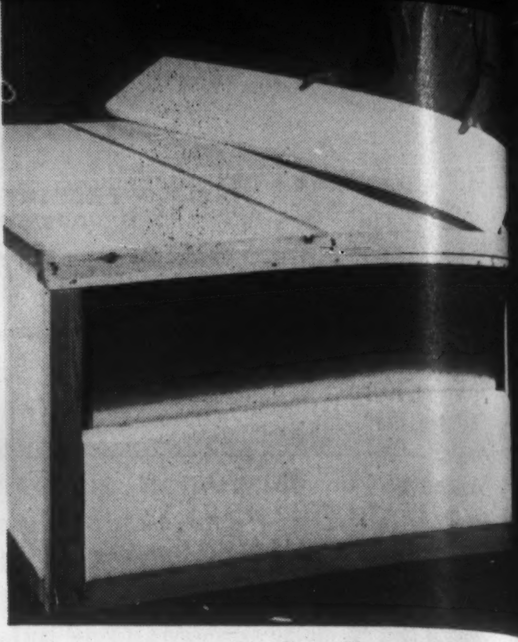
Furane Plastics, Inc.

Epoxy foams *combine excellent electrical, chemical characteristics of epoxy resins with light weight.*



Colton Chemical Co.

Cellular urea formaldehyde *can be used as insulation either in block or shredded form.*



Dow Chemical Corp.

Foamed polystyrene *(Styrofoam) is used as thermal insulation in Babson Bros.' milk cooler.*

Forming and fabrication—Cut boards or rough planks are available in many different dimensions. The material can be fabricated with conventional woodworking techniques, though simpler tooling and less power are required for Styrofoam than for wood. Styrofoam can also be cut with a heated electric resistance wire, or thin sections can be successfully die cut. A limited amount of postforming can be carried out.

Styrofoam can be bonded to itself or to other materials with the same types of adhesives used for foamed-in-place polystyrene, i.e., cold setting adhesives containing no solvents which attack polystyrene. Hot melt adhesives may be used if the temperature limitations of the foamed material are kept in mind. Where coatings are necessary or desirable, glossy and eggshell type finishes can be used. The material can be colored by water-base or latex emulsion paints as well as by alcohol solutions of dyes.

Cellulose acetate

Rigid cellulose acetate foam is formed by flash evaporation of a superheated solvent in a continuous extrusion process. It is being produced in densities ranging from 5 to 8 lb per cu ft and is available in standard foamed shapes without limitation on length. Maximum cross-section is governed by capacity of the extruder, which at present is 6 sq in. It is being produced under a Du Pont license by Strux Corp. as CCA.

CCA is noted for its thermal resistance and stability. It can be subjected to temperatures as high as 350 F for extended periods of time and 380 F intermittently without decomposition. Temperatures of —70 F decrease room temperature strength values by about 20%. Water absorption of the material, expressed in terms of reserve buoyancy after complete immersion in water, amounts to an initial buoyancy of 55 lb per cu ft which is reduced to 52 lb per cu ft after four days exposure in water. Complete recovery is realized after drying. Cured CCA has no odor and can be considered nontoxic. It has a high degree of shock and abrasion resistance. Table 11 lists typical properties.

The most important application of the material has been as a core in sandwich construction. It is particularly well suited for use in sandwich materials using glass-reinforced polyester or epoxy laminate skins. Either primary or secondary bonding operations can be used.

CCA has been used successfully as reinforcement for aircraft control surfaces, filler blocks for fuel cells, and as a buoyant material for marine applications. It is also gaining acceptance in the packaging field due to its high shock and abrasion resistance.

Forming and fabrication—Cellular cellulose acetate can be machined to close tolerances with conventional woodworking tools. Parts too large to be extruded can be produced by build-up techniques, using simple gluing procedures. Adhesives which work well with the material include polyesters, epoxies, ureas, phenol and resorcinol formaldehydes, vinyls and rubber-base cement.

GENERAL PRICE RANGES OF CELLULAR PLASTICS[a]

Foam	Density Range, lb/cu ft	Cost, $ / cu ft	Cost, $ / cu ft
Urethane	1-30	1.50-90.00	1.50-3.00
Vinyl	3.5-30	4.50-5.75	—
Polyethylene	—	—	0.54-0.75
Polystyrene			
Foamed-in Place	1-15	0.50-9.00	0.50-0.60
Prefoamed	1.7-2.3	0.94-1.24	0.55-0.57
Phenolic	0.3-25	0.15-15.00	0.25-0.60
Syntactic	20-40	7.50-25.00	—
Silicone	12-16	55.20-80.00	4.60-5.00
Cellulose acetate	6-8	7.80-10.40	1.30-1.50
Urea formaldehyde	8-10	4.80-6.00	0.60

[a] Prices are approximate, varying with quantity and are intended only to present indicative ranges. Also prices of some of the newer materials should be reduced in near future.

TABLE 10—PROPERTIES OF PREFOAMED POLYSTYRENE[a]

Density, lb/cu ft	1.3	1.6	2.0
Comp yld str, psi	10-20	15-25	25-35
Tens str, psi	30-45	50-70	80-100
Shear str, psi	15-25	25-35	35-45
Comp mod, psi	450-1100	750-1350	1150-1750
Bending mod, psi	200-750	650-1200	1200-1900
Impact str, psi	0.5-1.2	1.1-1.8	2.1-2.7

Thermal cond, BTU/hr/sq ft/F/in.	0.23-030 at 40 F
Linear coeff of thermal exp (−320 to 50 F) in./in./F	$2\text{-}5 \times 10^{-4}$
Specific heat, (at 40 F)Btu/lb/F	0.27
Resistance to heat (continuous use temp), F	175
Water absorption, % by vol.	<6
Water vapor transmission, gm/sq ft/hr/in./in. Hg vapor pressure difference	1.5-3.0

[a] Styrofoam #22, Dow Corning Corp.

TABLE 11—PROPERTIES OF CELLULAR CELLULOSE ACETATE[a]

Density, lb/cu ft	6-7	7-8
Tens str, psi	158	183
Shear str, psi	140	185
Comp str, psi	197	235
Comp mod, psi	5,500	13,500
Flex str, psi	147	177
Izod impact str, unnotched, ft-lb	0.01	1.15
Thermal conductivity, Btu/sq ft/hr/F/in.	0.31	0.32
Coeff of thermal expansion, F	2×10^{-5}	2×10^{-5}
Flame travel, in./min	4.9	4.2
Dielectric const	1.12	1.12
Loss tangent	0.002	0.002
Moisture absorption		
50% R.H., lb/cu ft	0.15	—
100% R.H. lb/cu ft	1.05	—

Chemical resistance—Resists weak acids, oils, fats, greases and gasoline but is soluble in alkalies, acetone, and lower ester type solvents; swollen by lower alcohols.

[a] CCA, Strux Corp.

Epoxies

The use of epoxies for production of foamed structures is a relatively recent development which has found only limited commercial acceptance. Epoxy foams have excellent chemical resistance, dielectric characteristics, toughness, adhesive qualities and a degree of heat resistance superior to most of the thermoplastic foams. They are available, with closed cell structure, as foamed blocks, foamed sheet, and from one manufacturer as a foamed-in-place formulation.

In general, epoxy foams are produced by the action of a suitable foaming agent which is introduced in a standard casting mix. When heated, the foaming agent decomposes releasing a gas which causes expansion. Expansion temperatures range from 220-260 F.

A white foam, designated DR 139-2 (De Bell & Richardson, Inc.) is available as 15 in. cubes. It has a density of 2 lb per cu ft, though higher densities can be produced. At present, only limited data are available. The material exhibits no shrinkage after 18 hr exposure to temperatures of 300 F; it has a compressive strength of 7 psi (25% compression); buoyancy after 18 hr in water of 69%; and remains unaffected after one month's immersion in styrene monomer. Compression under load at various temperatures on a 1½ x 1½ in. bearing surface is as follows:

Temp, F	Load, gm	Comp, %
150	100	1.5
212	60	6.0
250	60	19
300	60	75

Available only in sheet form, Eccofoam S (Emerson and Cuming) is being produced in bulk densities ranging from 3 to 25 lb per cu ft. As with other foams, physical properties are a function of bulk density. Compressive strength of the 3 lb per cu ft foam is 65 psi, and that of the 10 lb material is 340 psi. Eccofoam S can be fabricated with conventional wood working tools.

A foamed-in-place epoxy designated Epocast H865 (Furane Plastics, Inc.) has been developed which can be foamed to fill any cavity without application of external heat. A real advantage of the material is its long induction period. This permits fabricators more processing time between mixing and formation of the foam, and is particularly useful for production of large parts.

Immediate applications for epoxy foams would seem to lie in the electronics field for encapsulation of components and as a core material for plastics forming tools.

Urea-formaldehyde

An expanded urea-formaldehyde plastic, with an interwoven crystalline structure containing about 99% air by volume, is being produced by frothing a combination of water-soluble resins. The resulting white, fluffy mass is solidified and forms Colfoam (Colton Chemical Co.), which is one of the lightest organic foams commercially available. Its density is about 0.8 lb per cu ft. It is available in the form of blocks (about 20 x 10 x 4 in.) or as shredded insulation. Primary use for both the shredded and block material is as low temperature thermal and acoustical insulation.

Shredded Colfoam has a thermal conductivity (K factor) of 0.18

Btu/hr/sq ft/F/in. at 75 F. At 100 F the K value is 0.20. The material is satisfactory for continuous use at temperatures up to 120 F. Exposure to direct flame causes volatilization, but the material will not support combustion and is self-extinguishing. Colfoam is not affected by long exposure to extreme low temperatures. The material is noncorrosive and will not react unfavorably with metals.

When exposed to relative humidity of 95-97% for extended periods of time at 75 F the material absorbs not more than 20% of its own weight. Uncoated blocks of Colfoam float with 40% or more of their bulks above the surface, even after total immersion in water for two days. For soundproofing applications where light weight characteristics are desirable, Colfoam's Q factor of 123 (compared with 60-80 for Kapok) presents definite advantages.

The material is now being used for low temperature insulation in household and commercial refrigeration units, frozen food shipping containers, trailer truck installations and building refrigeration units. Applications in the display and novelty field seem promising. Possibilities of plastics-coated Colfoam for flotation gear are also being considered.

References

Allen, H. E., "Vinyl Foam", 12th Annual SPE Conference, 1956 Technical Papers, Vol II.

Arnold, H. E., "Cellular PVC Plastic and the Chemical Blowing Agent BL353", 12th Annual SPE Conference, 1956 Technical Papers, Vol II.

Franson, G. R., "Expandable Polystyrene Fabrication Methods and Applications", 12th Annual SPE Conference, 1956 Technical Papers, Vol II.

Harrington, C. J., "Polyurethane Foams", 12th Annual SPE Conference 1956 Technical Papers, Vol II.

Katz, I., "Recent Advances With Isocyanate Base Polymers", 11th Annual SPE Conference, 1955 Technical Papers, Vol I.

Kennedy, R. N., "Polystyrene Foam", SPE Journal, *9*, 11, Dec. '53.

Nelson, J. D., "Phenolic Foam", SPE Journal, *9*, 15, Dec. '53.

Acknowledgements

The author would like to thank the following individuals in particular for their assistance in preparing the manual: B. Collins, Nopco Chemical Co.; R. R. Heighling, Pelron Corp.; H. Weisel, Dow Chemical Co.; R. V. Bridi, Koppers Co.; H. E. Allen, Elastomer Chemical Co.; M. R. Kallman, Emerson & Cuming, Inc.; and W. J. Robinson, E. I. du Pont de Nemours & Co.

The author would also like to acknowledge the assistance of literature and personnel of the following companies:

Allied Chemical and Dye Corp., National Aniline Div.

American Latex Products Corp.

Bakelite Co., Div. of Union Carbide and Carbon Corp.

Colton Chemical Co., Div. of Air Reduction Co., Inc.

De Bell & Richardson, Inc.

Dow Corning Corp.

E. I. du Pont de Nemours & Co.

Furane Plastics, Inc.

Interchemical Corp.

Isocyanate Products, Inc.

Marblette Corp.

Naugatuck Chemical Div., U.S. Rubber Co.

Rezolin, Inc.

Rohm and Haas Co.

Shell Chemical Corp.

Strux Corp.

Suppliers of foam plastics

Below is a partial list of suppliers of each of the types of expanded plastics discussed in the manual.

FLEXIBLE

Urethane (Foam Bases & Molded Products)
  American Latex Products Corp., Hawthorne, Calif.
  E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.[a]
  General Tire and Rubber Co., Akron, Ohio[b]
  Hudson Foam Plastics Corp., Yonkers, N.Y.[b]
  Isocyanate Products, Inc., Wilmington, Del.[c]
  Mobay Chemical Co., St. Louis, Mo.[d]
  Nopco Chemical Co., Harrison, N.J.
  Pelron Corp., Lyons, Ill.[e]
Vinyl
  Crest Industries, Brooklyn, N.Y.[f]
  Elastomer Chemical Corp., Newark, N.J.[a]
  Foam King, Inc., Bronx, N.Y.[f]
  Interchemical Corp., New York, N.Y.[g]
Polyethylene
  Bakelite Co., Div. of Union Carbide and Carbon Corp., New York, N.Y.

RIGID, FOAM-IN-PLACE

Polystyrene (Foamed-In-Place)
  Koppers Co., Pittsburgh, Pa.
Phenolics
  Bakelite Co., Div. of Union Carbide and Carbon Corp., New York, N.Y.
  General Electric Co., Chemical and Metallurgical Div., Pittsfield, Mass.
  Marblette Corp., Long Island City, N.Y.
  Rezolin, Inc., Los Angeles, Calif.
  Westinghouse Electric Corp., Pittsburgh, Pa.
Syntactic Microballoons
  Bakelite Co., Div. of Union Carbide and Carbon Corp., New York, N.Y.
  Colton Chemical Co., Div. of Air Reduction Co., Inc., Cleveland, Ohio
Silicones
  Dow Corning Corp., Midland, Mich.

RIGID, PREFOAMED

Polystyrene (Prefoamed)
  Dow Chemical Corp., Midland Mich.
Cellulose Acetate
  Strux Corp., Lindenhurst, N.Y.
Epoxies
  Aries Laboratories, New York, N.Y.
  De Bell & Richardson, Inc., Hazardville, Conn.
  Emerson and Cuming, Canton, Mass.
  Furane Plastics, Inc., Los Angeles, Calif.[h]
Urea Formaldehyde
  Colton Chemical Co., Div. of Air Reduction Co., Inc., Cleveland, Ohio

[a] Licenser only.
[b] Supplies only molded products.
[c] Supplies foam bases only.
[d] Licenser, supplies no molded products.
[e] Only current supplier of polyether prepolymer foam bases.
[f] Suppliers of "blowing agent" type molded products.
[g] Suppliers of "blowing agent" type foam bases.
[h] Foam-in-place epoxy.

Reprints of this (and other) Manuals are available at 25¢ each until supply is exhausted. See page 222 for complete list of available Manuals. Write for quotations on quantities of 100 or more. Address requests to Reader Service Dept., MATERIALS & METHODS, 430 Park Ave., New York 22, N. Y.

MATERIALS ENGINEERING FILE FACTS

Forgeable Metals and Forging Design

FORGEABLE METALS

1. **Carbon Steels.** a) Low-carbon (up to 0.25%) forgings for moderate conditions and for carburized parts where resistance to abrasion is important. b) Medium-carbon (0.30% to 0.50%) forgings for more severe service. Some heat treatment is generally desirable. c) High-carbon (above 0.50%) forgings for hard surfaces and springs. Heat treatment is essential to obtain other desired properties.

2. **Alloy Steels** (manganese, nickel, nickel-chromium, molybdenum, chromium, vanadium, chromium-vanadium, tungsten, silicon-manganese). These steels, as the name implies, are alloys of carbon steel with one or more additional elements. Forgings from these steels are used wherever higher strength, resistance, durability, etc., are wanted. The proper selection of a particular analysis, together with its subsequent heat treatment, depends upon the particular service requirements of the part in question and is within the province of the metallurgist in consultation with the forging engineer.

3. **Corrosion and Heat-Resisting, and Stainless Steels.** The steels commonly used for resistance to corrosion or stain and for heat resistance are alloy steels usually high in chromium or nickel, or both. The particular type of corroding agent to be encountered determines the best analysis. Generally, but not necessarily, forged surfaces should be polished to obtain full benefit of corrosion-resisting properties.

4. **Iron.** Either wrought iron or ingot iron is forged for special applications where ductility is required. Wrought iron furnishes a moderate degree of corrosion resistance. The copper-bearing irons and low-carbon steels are in this class.

5. **Copper, Brasses, Bronzes.** Copper forgings have extensive applications in the electrical field. The brass and bronze alloys have moderate corrosion-resistant properties. Some of the bronzes have moderately high strength and good bearing properties.

6. **Nickel, and Nickel-Copper Alloys.** Pure nickel is forgeable. The alloy of nickel and copper known as Monel metal offers a desirable combination of strength, toughness, and corrosion resistance.

7. **Light Alloys** (aluminum, magnesium). The light alloys have about one-third the weight of steel and some have been developed to approximately the strength of low-carbon steel. Forgeable alloys are available in both the aluminum and magnesium groups.

COMMERCIAL FORGING PRACTICE

Impression die forgings are sold by the piece and not by the pound. It is understood without specific mention that the excess metal or flash of forgings shall be removed by trimming, and that forgings shall be free from injurious defects.

1. **Quantity.** The quantity specified permits standard practice limits on over-runs and under-runs.

2. **Size.** Forgings within commercial size limits will be furnished unless closer tolerances are specified.

3. **Coining or Sizing.** Closer tolerances may be obtained by additional hot or cold sizing operations.

4. **Surfacing Conditions.** Forgings are furnished in a cleaned condition by either tumbling, pickling or blast-cleaning unless otherwise specified.

5. **Special Requirements.** Any special requirement, such as heat treatment or special tests, should be clearly stated.

6. **Preparation Charges.** The production of impression die forgings requires the preparation of special dies and tools which may be charged to the customer as a separate item called "preparation charges." The customer has the exclusive right to use such dies and tools, but because the full cost is generally not included in such a charge he does not have the right to remove them without additional payment. Any such dies and tools are maintained in the future without further charges to the customer.

DRAFT ANGLE TOLERANCES

	Drop Forgings		Upset Forgings	
	Outside, deg	Inside Holes, deg	Outside, deg	Inside Holes, deg
Nominal angle	7	7 or 10	3	5
Commercial limits	0—10	0—13	0—5	0—8
Close limits	0—8	0—8	0—4	0—7

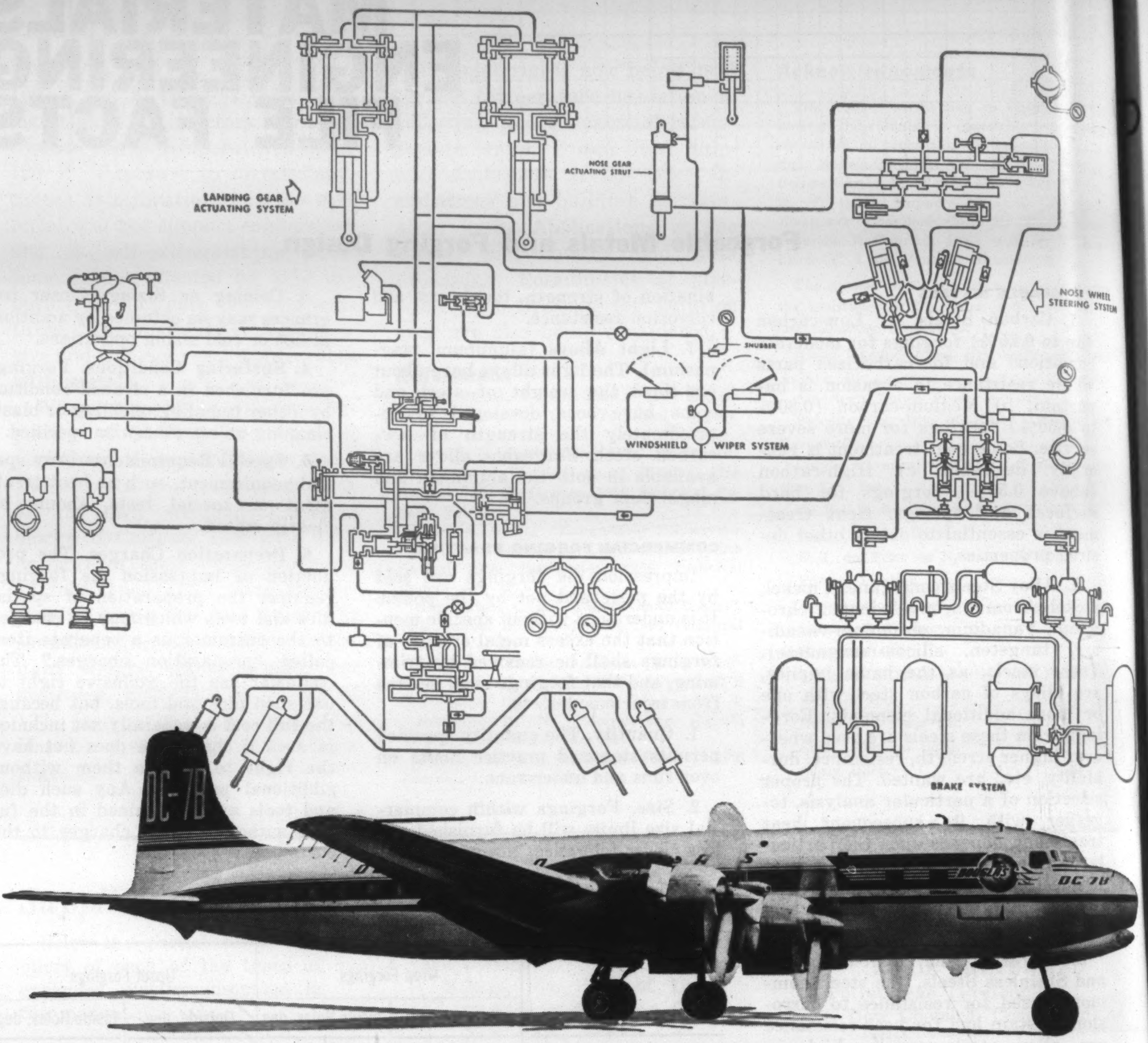
MISMATCHING TOLERANCES

Net weight up to	Commercial, in.	Close, in.
1 lb.	0.015	0.010
7 lb.	0.018	0.012
13 lb.	0.021	0.014
19 lb.	0.024	0.016
Each additional 6 lb. add	0.003	0.002
For example:		
37 lb.	0.033	0.022
55 lb.	0.042	0.028

Mismatching is the displacement of a point in that part of a forging formed by one die block of a pair, from its desired position when located from the part of the forging formed in the other die block of the pair. Mismatching does not include any displacement caused by variation in thickness of the forging, but is only the displacement in a plane parallel to the main or fundamental parting plane of the dies.

Mismatching tolerances are independent of, and in addition to, any other tolerances.

◄ For more information, Circle No. 536


LANDING GEAR ACTUATING SYSTEM
NOSE GEAR ACTUATING STRUT
NOSE WHEEL STEERING SYSTEM
SNUBBER
WINDSHIELD WIPER SYSTEM
BRAKE SYSTEM
DC-7B
DC-7B

Enjay Butyl rubber—vital artery in newest airliners

Douglas chooses Enjay Butyl for rubber components of the hydraulic systems in many of its famous DC-7 airliners. These components, which help assure the dependable operation of everything from wing flaps to landing gear, are proving over millions of air miles their durability and resistance to wear.

Versatile Enjay Butyl rubber may well have a place in *your* operation. It will pay you to investigate the many technical advantages it has over other types of rubber. Its price and ready availability are advantages, too. For full information, and for technical assistance in the uses of Enjay Butyl, contact the Enjay Company today.

ENJAY
BUTYL

ENJAY *Pioneer in Petrochemicals*

ENJAY COMPANY, INC., 15 West 51st Street, New York 19, N. Y.
Other offices: Akron • Boston • Chicago • Los Angeles • Tulsa

Enjay Butyl is the super-durable rubber with *outstanding* resistance to aging • abrasion • tear • chipping • cracking • ozone and corona • chemicals • gases • heat • cold • sunlight • moisture.

For more information, turn to Reader Service Card, Circle No. 462

MATERIALS ENGINEERING FILE FACTS

Forgeable Metals and Forging Design (continued)

FILLET AND CORNER TOLERANCES

Max Net Wt	Commercial, in.	Close, in.
0.3 lb	3/32	3/64
1.0 lb	1/8	1/16
3.0 lb	5/32	5/64
10.0 lb	3/16	3/32
30.0 lb	7/32	7/64
100.0 lb	1/4	1/8

Fillet and Corner Tolerances apply to all intersection surfaces even though drawings or models indicate sharp corners. If such drawings or models have or indicate fillet or corner dimensions of larger radii than the following standards, such larger dimensions shall be considered as actually specified and the tolerances shall be "special tolerances."

Where a corner tolerance applies on the meeting of two drafted surfaces, the tolerance shall apply to the narrow end of such meeting and the radius will increase toward the wide end. The total increase in the radius will equal the length of the drafted surface in inches, multiplied by the tangent of the nominal draft angle.

SHRINKAGE AND DIE WEAR TOLERANCES

	Shrinkage			Die Wear	
Length or Width, in.	Commercial, in. + or −	Close, in. + or −	Max Net Wt, lb.	Commercial, in. + or −	Close, in. + or −
1	0.003	0.002	1	0.032	0.016
2	0.006	0.003	3	0.035	0.018
3	0.009	0.005	5	0.038	0.019
4	0.012	0.006	7	0.041	0.021
5	0.015	0.008	9	0.044	0.022
6	0.018	0.009	11	0.047	0.024
For each additional in. add	0.003	0.0015	For each additional 2 lb. add	0.003	0.0015
For example:			For example:		
7	0.021	0.011	13	0.050	0.026
12	0.036	0.018	21	0.062	0.031

Shrinkage and die wear tolerances shall not be applied separately. They shall be applied as the sum of the two and shall be measured in such a way as to eliminate draft or variations in draft. They apply to that part of the forging formed by a single die block, and to no dimension crossing the parting plane.

THICKNESS TOLERANCES

Max Net Wt	Commercial, in.		Close, in.	
	Minus	Plus	Minus	Plus
0.2	0.008	0.024	0.004	0.012
0.4	0.009	0.027	0.005	0.015
0.6	0.010	0.030	0.005	0.015
0.8	0.011	0.033	0.006	0.018
1.0	0.012	0.036	0.006	0.018
2.0	0.015	0.045	0.008	0.024
3.0	0.017	0.051	0.009	0.027
4.0	0.018	0.054	0.009	0.027
5.0	0.019	0.057	0.010	0.030
10.0	0.022	0.066	0.011	0.033
20.0	0.026	0.078	0.013	0.039
30.0	0.030	0.090	0.015	0.045
40.0	0.034	0.102	0.017	0.051
50.0	0.038	0.114	0.019	0.057
60.0	0.042	0.126	0.021	0.063
70.0	0.046	0.138	0.023	0.069
80.0	0.050	0.150	0.025	0.075
100.0	0.058	0.174	0.029	0.087

Thickness Tolerances for drop hammer forgings apply to the over-all thickness measured in a direction perpendicular to the fundamental parting plane of the dies. For upset forgings, thickness tolerances apply to the metal actually enclosed and formed by the dies, measured parallel to the direction of travel of the ram.

QUANTITY TOLERANCES

Number of pieces on order	Over-run Pieces	Under-run Pieces
1—2	1	0
3—5	2	1
6—19	3	1
20—29	4	2
30—39	5	2
40—49	6	3
50—59	7	3
60—69	8	4
70—79	9	4
80—99	10	5
	Percent	Percent
100—199	10	5.0
200—299	9	4.5
300—599	8	4.0
600—1249	7	3.5
1250—2999	6	3.0
3000—9999	5	2.5
10,000—39,999	4	2.0
40,000—299,999	3	1.5
300,000 up	2	1.0

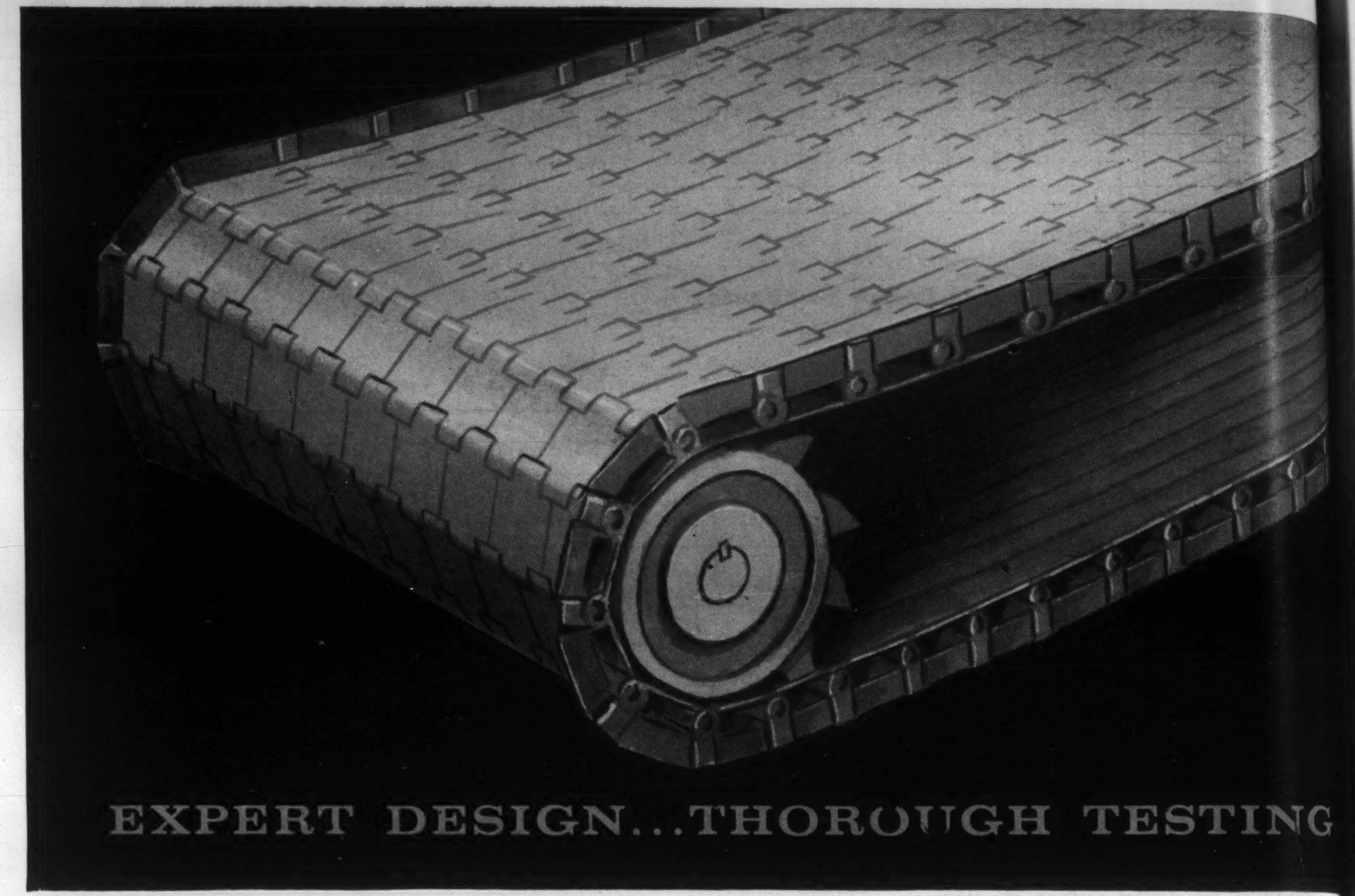
Quantity tolerances shall be the permissible over- or under-run allowed for each release or part shipment of an order. Any shipping quantity within the limits of over- and under-run shall be considered as completing the order. Commercial and close tolerances shall be the same amounts.

NOTES:

Standard tolerances given on these pages are for forgings up to 100 lb.

Special tolerances may be specified when regular tolerances are not applicable. Regular tolerances, shown here, are classed as "Commercial Standard" and "Close Standard."

(Courtesy of Drop Forging Association)



MAKE THE DIFFERENCE IN

Thermalloy*

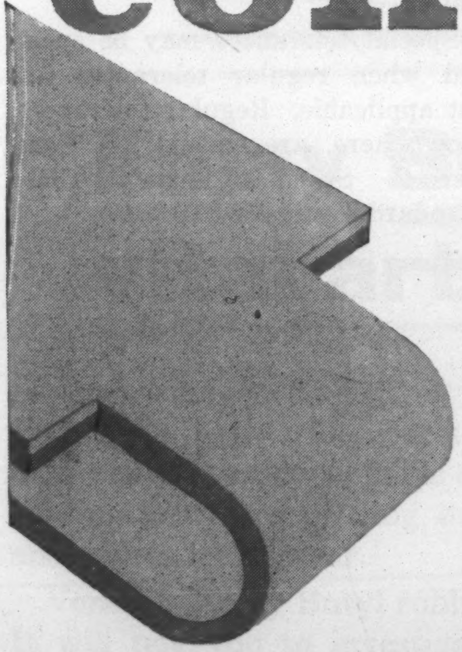
conveyor belts

It takes expert design *and* the right alloy to make conveyor belts that will stand up under your specific load and temperature conditions. That's why Electro-Alloys engineers first study the operating conditions of your installation . . . and why our metallurgical staff carefully controls the production of every high-heat-resistant Thermalloy conveyor part.

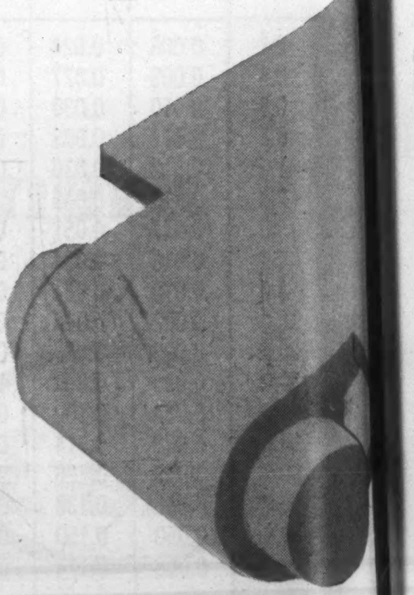
But design by itself isn't enough. We thoroughly test Thermalloy conveyor belts under actual load and temperature conditions! In our physical laboratory, a hot tensile machine constantly checks Thermalloy conveyor belts. Over a long period of testing in this machine, we've been able to establish load curves, apply tensions (up to 30 tons) to test short-time fractures and observe long-time creep. Finally, test runs are conducted at our plant as a control measure to assure proper operation of belts.

For further information on Thermalloy conveyor belts, write for Bulletin T-241, Electro-Alloys Division, 7026 Taylor Street, Elyria, Ohio.

*Registered U. S. Pat. Off.



General-purpose
Typical 3" or 4" pitch center link of loop-type casting design.



Heavy-duty
Typical heavy-duty link wi
integral cast pin to elim
nate "crank-shafting".

AMERICAN
Brake Shoe
COMPANY

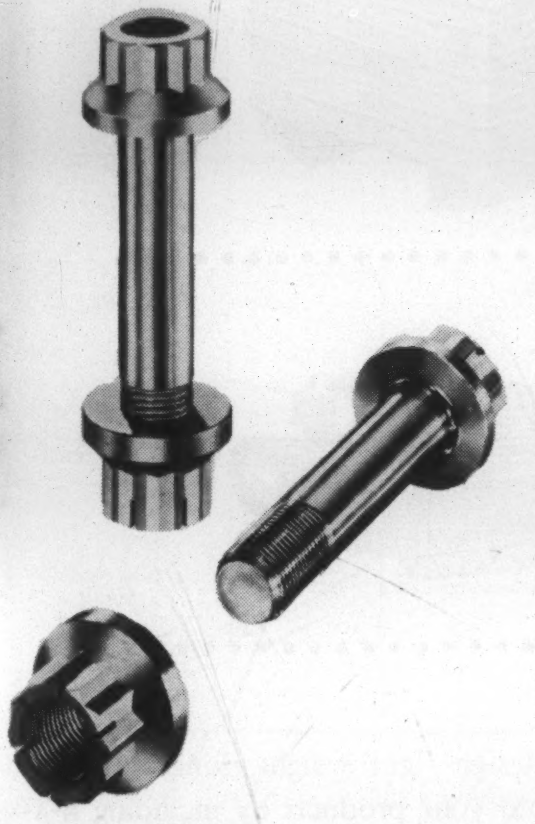
ELECTRO-ALLOYS DIVISION
Elyria, Ohio

For more information, turn to Reader Service Card, Circle No. 512

NEW MATERIALS PREVIEWS

This month

- ▶ *High strength bolts*
- ▶ *Silicone rubber compounds and other new materials, p 169*



Aircraft bolts *with tensile strength to 240,000 psi permit weight reduction in structural design.*

220,000 Psi Steel Bolt

To be used in jet interceptor

■ A new external wrenching bolt that was designed primarily for aircraft may have broad application in industrial design. It has tensile strengths of 220,000 to 240,000 psi, said to be the highest yet attained in a practical threaded fastener. This strength level is about 40% greater than that of the best standard high strength aircraft bolts now in use, the 160,000 psi MS 20004 series.

The fasteners, called Hi-Psi bolts, were developed by *Standard Pressed Steel Co.*, Jenkintown, Pa. They will be used for the first time on the new F-102A delta-wing jet interceptor by Convair Div. of General Dynamics Corp. The supplier foresees their use in other aircraft as a size-in-size substitute for present-day bolts to strengthen existing designs.

Properties

These new bolts have a minimum shear strength of 130,000 psi as compared to 95,000 psi minimum for current high strength aircraft shear bolts. Despite their high static tensile strength, these bolts have greater fatigue strength—as much as 78% greater—than the strongest standard steel bolts now in use.

As a result, one ⅜-in. dia Hi-Psi bolt is claimed to do the work of an ordinary 7/16-in. steel bolt. This substitution cuts bolt weight alone by almost 30%. Actual size and weight reductions can be much greater than this since a smaller bolt in a smaller hole permits use of smaller connecting structural members.

The company has compared the properties of both the ⅜-in. and ½-in. Hi-Psi bolts with comparable 160,000 psi MS-20004 series bolts. Their report indicates a tensile strength at the pitch thread area of 240,000 psi for the ⅜-in. Hi-Psi bolt, compared to 164,000 psi for the ⅜-in. MS bolt. Tensile strengths for the ½-in. Hi-Psi and MS bolts tested were 231,000 and 173,000 psi, respectively.

Fatigue strength of the ⅜-in. Hi-Psi was 82,000 psi at 8,000,000

HOW NEW BOLTS COMPARE WITH THE OLD

	⅜-24 Dia		½-20 Dia	
	Old MS20006	New EWB 22-6	Old MS20008	New EWB 22-8
Tensile strength, psi				
Root thread area	192,800	281,000	199,900	266,600
Mean thread area	178,100	260,300	186,000	248,100
Pitch thread area	164,000	239,800	172,900	230,600
Bolt gage specimen[a]	170,000	237,200	174,400	235,200
Yield strength, psi				
Root thread area	155,800	229,900	171,600	217,000
Mean thread area	143,800	212,300	159,700	201,900
Pitch thread area	132,500	195,600	148,400	188,700
Bolt gage specimen[a]	148,000	202,000	158,700	211,000
Elongation, % in 4 dia (bolt gage specimen[a])	14.5	12.5	15.6	13.5
Reduction in area, % (bolt gage specimen[a])	52.4	51.2	56.6	49.3
Shear strength, psi (bolt body)	100,200	138,300	106,200	137,500
Fatigue strength lb at 8 million cycles (10% preload)	3500	6750	7850	11,180

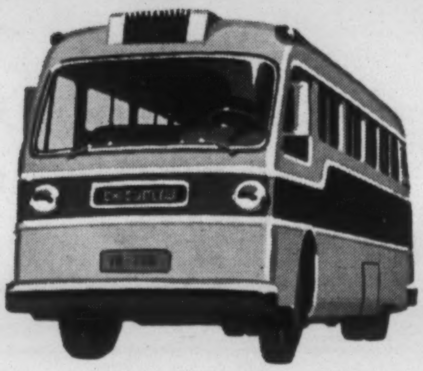
[a] Specimen diameter 0.252 in. for ⅜-in. bolts, 0.357 in. for ½-in. bolts.

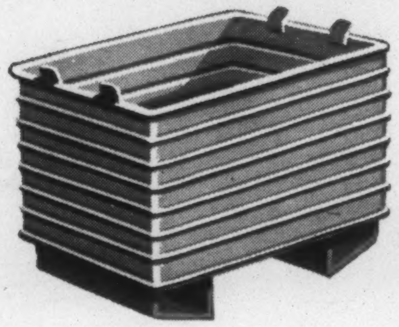
MAKE IT WEIGH LESS

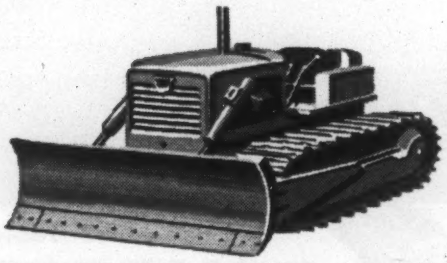
N·A·X

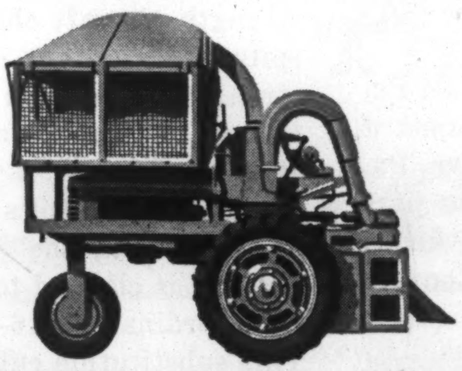
HIGH-TENSILE STEEL

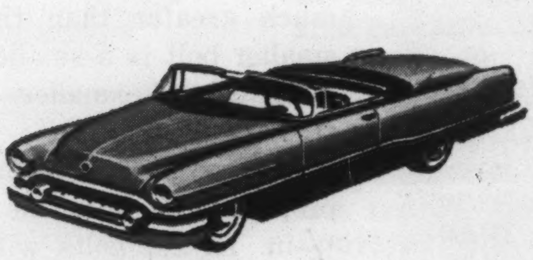
MAKE IT LAST LONGER











You can design light weight, longer life, and economy into your products by including N-A-X HIGH-TENSILE in your plans.

- It is 50% stronger than mild steel.
- It is considerably more resistant to corrosion.
- It has greater paint adhesion with less under-coat corrosion.
- It has high fatigue life with great toughness.
- It has greater resistance to abrasion or wear.
- It is readily and easily welded by any process.
- It polishes to a high luster at minimum cost.

And, with all these physical advantages over mild carbon steel, it can be cold formed as readily into the most difficult shaped stamping.

When you next start to redesign, get the facts on N-A-X HIGH-TENSILE. It's produced by Great Lakes Steel – long recognized specialists in flat-rolled steel products.

N-A-X Alloy Division

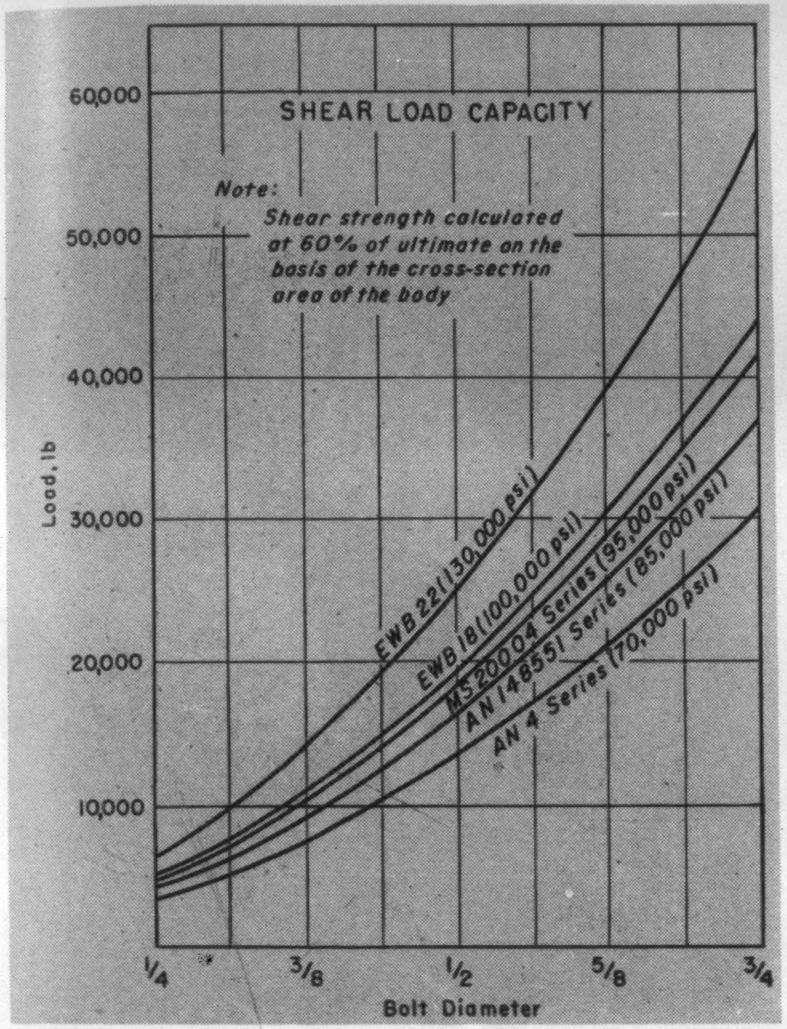
GREAT LAKES STEEL CORPORATION

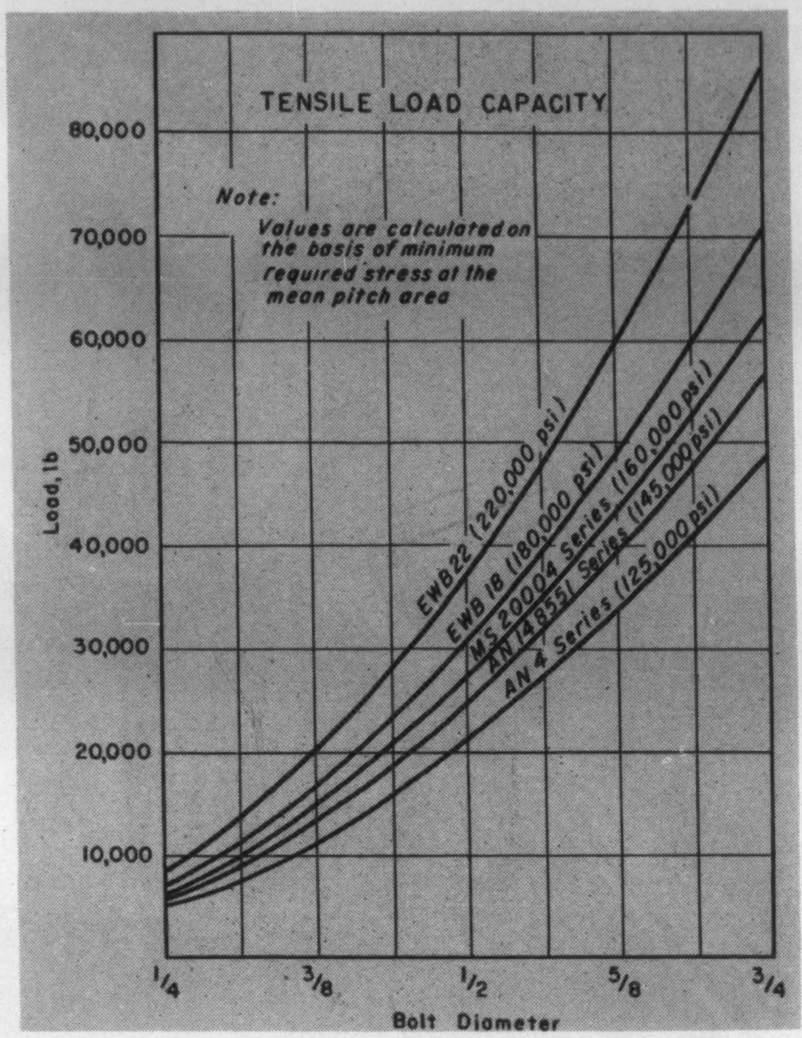
Ecorse, Detroit 29, Mich. • A Unit of

NATIONAL STEEL CORPORATION

For more information, turn to Reader Service Card, Circle No. 429

NEW MATERIALS PREVIEWS





How Hi-Psi bolts compare *with other high strength fasteners. A weight saving of almost 30% is expected with the new bolt.*

load cycles, 78% greater than the 46,000 psi fatigue strength of the MS bolt. Fatigue strength of the ½-in. Hi-Psi was 76,000 psi, 66% greater than the 47,000 psi value for the ½-in. MS. Other mechanical properties are shown in the accompanying table.

Design and development

Ordinarily, high tensile strength steel would be too brittle for the job performed by Hi-Psi fasteners. Ductility was increased by a series of design and processing innovations. These techniques included:

1. A carefully controlled heat treating technique that brings out more of the properties of the high strength alloy steel.
2. Special cleaning, plating and prolonged thermal treatment to minimize hydrogen embrittlement, a major cause of fatigue failures in ordinary bolts.
3. Special surface finishing to near-mirror smoothness to eliminate surface flaws that might induce fatigue failure.
4. A new thread design, called Hi-R, that features a root radius 30% larger than that on standard fasteners. The larger root radius reduces the stress concentrations that lower fatigue strength.
5. A technique for fully forming flaw-free threads after heat treatment in steel of extreme hardness.
6. Surface treating of the fillet area where the head of the bolt joins the shank.
7. A new bolt and head nut configuration of 12-point external wrenching design that improves tensile and fatigue characteristics and facilitates tightening.

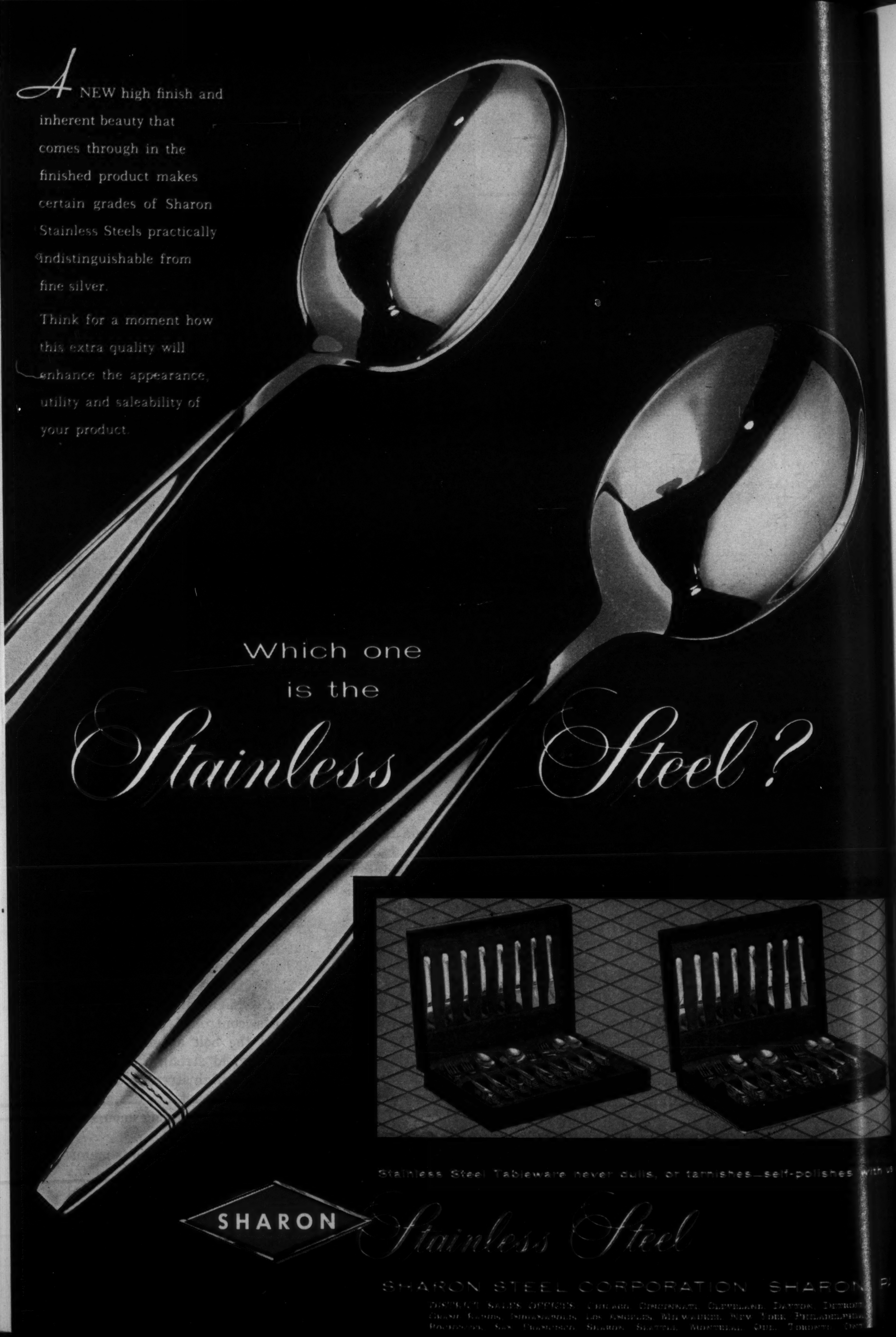
Bolt assembly

The complete fastener assembly has three parts:

1. The Hi-Psi bolt, a 12-point external wrenching bolt, designated EWB-22 to indicate its type and its minimum tensile strength.
2. An automatic preload indicating washer, called PLI-22, that permits controlled tightening to preload the bolt automatically to 80% of yield strength.
3. A new high strength external wrenching locknut, designated EWN-22, that is strong enough to break the bolt.

Standard Pressed Steel is manufacturing Hi-Psi fasteners in ¼- to 1¼-in. dia. Bolts, nuts and washers are cadmium plated to military specifications.

(Other New Materials on p 169)



A NEW high finish and inherent beauty that comes through in the finished product makes certain grades of Sharon Stainless Steels practically indistinguishable from fine silver.

Think for a moment how this extra quality will enhance the appearance, utility and saleability of your product.

Which one is the *Stainless Steel?*

Stainless Steel Tableware never dulls, or tarnishes—self-polishes with us

SHARON *Stainless Steel*

SHARON STEEL CORPORATION SHARON, P

DISTRICT SALES OFFICES: Chicago, Cincinnati, Cleveland, Dayton, Detroi
Grand Rapids, Indianapolis, Los Angeles, Milwaukee, New York, Philadelphi
Rochester, San Francisco, Sharon, Seattle, Montreal, Que., Toronto, Ont

OTHER NEW MATERIALS, PRODUCTS

Silicone Rubbers Designed for Sponging

■ Two new compounds designed specifically for the production of expanded unicellular silicone rubber are now in the developmental stage at the *Silicone Products Dept., General Electric Co.*, Waterford, N. Y. Sponge made from these compounds may be used at temperatures as low as —120 F and as high as 500 F.

Production flexibility

In the past, silicone rubber sponge has ordinarily been made from compounds designed for other applications. According to G-E, these new compounds greatly increase the time that may elapse between the freshening-forming step and the cure—with little or no loss in expansion. Freshened life is a minimum of 8 hr and may be as long as 24 hr. The result is more flexibility in production operations.

The new compounds are designated 81597 and 81601. Compound 81597 is white and has an uncured specific gravity of 1.21-1.24. Compound 81601 is neutral and may be colored as desired. Its uncured specific gravity is 1.17-1.19. Mechanical properties of both the expanded and unexpanded compounds are given in the accompanying tables.

Heat aging

Heat aging tests (ASTM D 1056-54T) have also been performed on 81597. Specimens were cut from mold-expanded sheets having 280 to 310% expansion. The sheets were cure-expanded, being press cured 10 min at 300 F, then oven aged 14 days at 350 F. Load required for 25% deflection was increased to 13 psi, and load for 50% deflection to 28 psi. Compression set after 22 hr at 86 F was increased to 4%, and compression set after 22 hr at 212 F was 8%.

In order to maintain uniformity, G-E supplies these compounds without blowing agent, which must be incorporated by the fabricator during the freshening operation. Other advantages claimed for 81597 and 81601 are: 1) batch to batch reproducibility of percent volume expansion, 2) ability to be blown and cured to optimum expansion in 10 to 20 min at temperatures as low as 300 F, 3) ability to be extruded for free-expansion or mold-expension process, 4) ability to fill a mold volume and be cured in one operation, and 5) uniform, unicellular cross-sections.

(Other New Materials on p 170)

COMPRESSION SET OF MOLD-EXPANDED SHEETS

Oven Cure	% Compression Set at Elevated Temperatures[a]					
	86 F		212 F		350 F	
	81597	81601	81597	81601	81597	81601
None	10	2	55	70	—	—
20 hr at 300 F	3	1	10	30	—	—
4 hr at 400 F	15	4	20	50	—	—
24 hr at 480 F	1	2	7	5	30	25

[a] ASTM D 1056-54T, 50% compression for 22 hr. 81597 specimens cut from sheets having 280 to 310% expansion, 81601 specimens cut from sheets having 260 to 275% expansion. Sheets cure-expanded, press cured 10 min at 300 F, oven cured as indicated.

PHYSICAL PROPERTIES OF PRESS CURED (UNEXPANDED) COMPOUNDS[a]

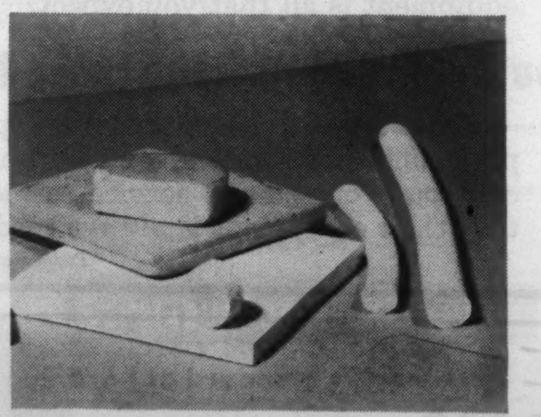
	81597	81601
Hardness, Shore A	45 ±5	45 ±5
Tensile strength, psi	800	800
Elongation, %	250	200

[a] Unexpanded ASTM slabs press cured for 10 min at 270 F, oven cured 24 hr at 300 F.

COMPRESSION-DEFLECTION OF MOLD-EXPANDED SHEETS[a]

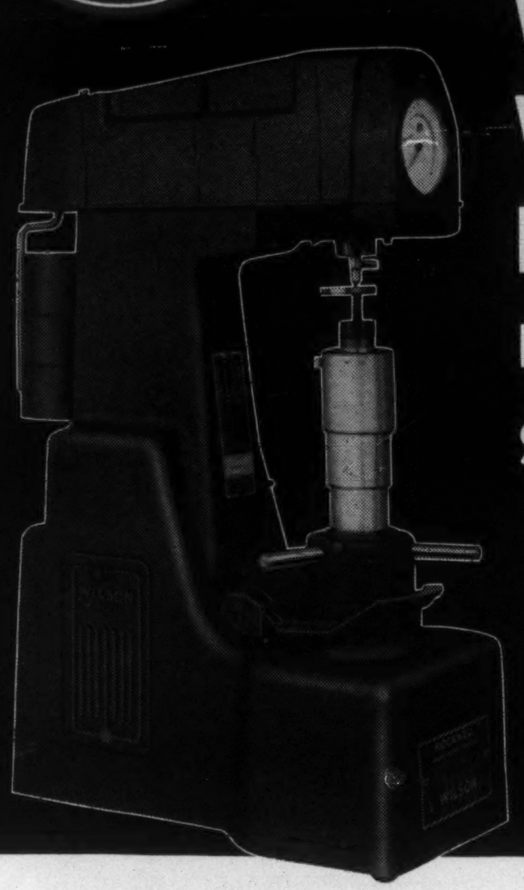
Oven Cure	Load to Compress 25%, Psi		Load to Compress 50%, Psi	
	81597	81601	81597	81601
None	5	10	15	28
20 hr at 300 F	8	13	17	34
4 hr at 480 F	6	13	16	37
24 hr at 480 F	8	18	19	43

[a] ASTM D 1056-54T. Specimens cut from sheets having 285 to 300% expansion, press cured 10 min at 300 F, oven cured as indicated.



Silicone rubber sponge. *Cylindrical pieces are free-blown extrusions. Flat pieces were molded.*

◄ For more information, Circle No. 384



ACCO products

Wilson "Rockwell"* Hardness Testers

Why WILSON ROCKWELL means accuracy, speed and economy EVERYWHERE

8" Capacity
Rockwell Hardness Tester

• WILSON field service is the best we know how to make it. In every industrial area, WILSON offices are well staffed with factory-trained experts who "practically eat and sleep" hardness testers. ***These experts help make sure that—***

You Get the Hardness Tester You Need

Whether your hardness tester is required for use in laboratory, tool room, inspection department or on the production line, there is a WILSON model to serve you best.

Consultation is as Close as the Phone

Changing work conditions frequently call for different accessories, sometimes a different model of tester. A WILSON expert is never more than a few hours away to make sure that the service you get from your WILSON equipment is all that you expect.

You Get Prompt Service if You Need It

Hardness testers must always operate at peak efficiency. WILSON owners know they can count on WILSON service to make sure that their equipment is always ready.

**Trademark registered*

A FULL LINE TO MEET EVERY HARDNESS TESTING REQUIREMENT

FULLY AUTOMATIC
•
SEMI-AUTOMATIC
•
REGULAR
•
SPECIAL
•
SUPERFICIAL
•
TUKON
MICRO & MACRO

WILSON "ROCKWELL"...

the world's standard of hardness accuracy

ACCO Wilson Mechanical Instrument Division
AMERICAN CHAIN & CABLE
230-E Park Avenue, New York 17, N. Y.

TRADE MARK A·C·C

for Better Value

For more information, turn to Reader Service Card, Circle No. 396

OTHER NEW MATERIALS, PRODUCTS

Other New Silicone Rubber Compounds

Two new silicone rubber compounds have been announced:

AMS 3301B material—A red colored, 40 durometer hardness material, called X-1034R, has been developed by *Silicones Div., Union Carbide & Carbon Corp.*, 30 E. 42nd St., New York 17. It is claimed to meet fully the requirements of AMS 3301B. It has shown excellent resistance to high temperatures, low compression set and low moisture pick up. It can be molded, extruded or calendered with conventional or special catalysts. With di-tertiary-butyl peroxide catalyst, it can also be used for thick sections.

Class 300 compounds—The first silicone rubber compounds claimed to have the same shrinkage as organic rubber have been developed by *Silicone Products Dept., General Electric Co.*, Waterford, N. Y. The three improved Class 300 compounds are designated SE-361, SE-371 and SE-381. They are said to make possible, for the first time, the molding of silicone rubber parts in the same molds used for organic rubber parts. These compounds also offer unusually low compression set without toxic additives. They may be cured equally well by mold, air vulcanization or steam methods.

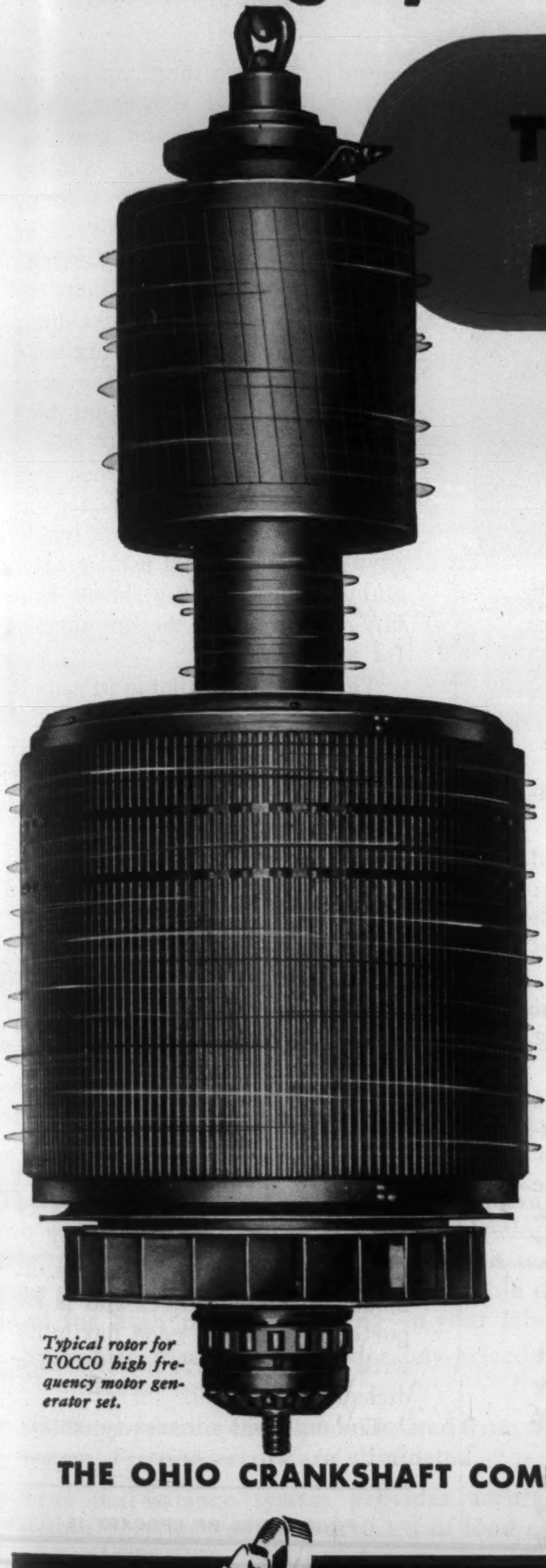
Hollow Aluminum Bar for Machined Parts

Hollow aluminum bar stock, developed by *Harvey Aluminum Div.*, 19200 S. Western Ave., Torrance, Calif., is claimed to offer substantial savings over conventional solid screw machine stock. Savings are attributed not only to lower materials cost but also to lower machining costs. The aluminum alloy used is 6066.

Since no time is required to rough out a cavity, the hollow bar stock is claimed to increase the

"Nothing Spins Like a Top"... *except*

TOCCO's VERTICAL Hi-Frequency Motor-Generator Sets



Typical rotor for TOCCO high frequency motor generator set.

First with Vertical MG Sets—*TOCCO*

In 1943 TOCCO designed and built the first vertical motor-generator sets for furnishing hi-frequency power for induction heating applications. Now with thirteen years of continuous production experience, we are far and away the world's largest supplier of these units.

Advantages of *TOCCO* Vertical MG Sets

The large TOCCO vertical type motor generator set has numerous advantages over conventional horizontal type sets. Vertical construction permits the use of very large bearings and also minimizes the hazard of major damage to the set in the unlikely event of a bearing failure. Longer bearing life is achieved due to lower pressure and uniform loading of the bearings. Maintenance is greatly simplified because the rotor can be removed vertically with a simple hoist. Anti-vibration mountings between the base and the MG rotor-stator assembly practically eliminate vibration. No special foundations are needed. Lastly, TOCCO's vertical design cuts necessary floor space to less than one-half the area required by horizontal motor-generator sets.

TOCCO Vertical MG sets are available in sizes up to 350 KW and frequencies from 1000 to 10,000 c.p.s.

Only Time-Tested Vertical MG Sets—*TOCCO*

There are over a thousand TOCCO vertical MG sets in actual service TODAY—more than all competitive horizontal makes combined. Write us for descriptive bulletin giving full details on the advantages and construction details of TOCCO Vertical MG Sets.

THE OHIO CRANKSHAFT COMPANY

TOCCO*

JUST PUSH A BUTTON

*Trade Mark Reg. U. S. Pat. Off.

NEW FREE BULLETIN — *Mail Coupon Today*

THE OHIO CRANKSHAFT CO.
Dept. T-6, Cleveland 5, Ohio

Please send copy of "TOCCO High Frequency Motor-Generator Sets."

Name________________

Position________________

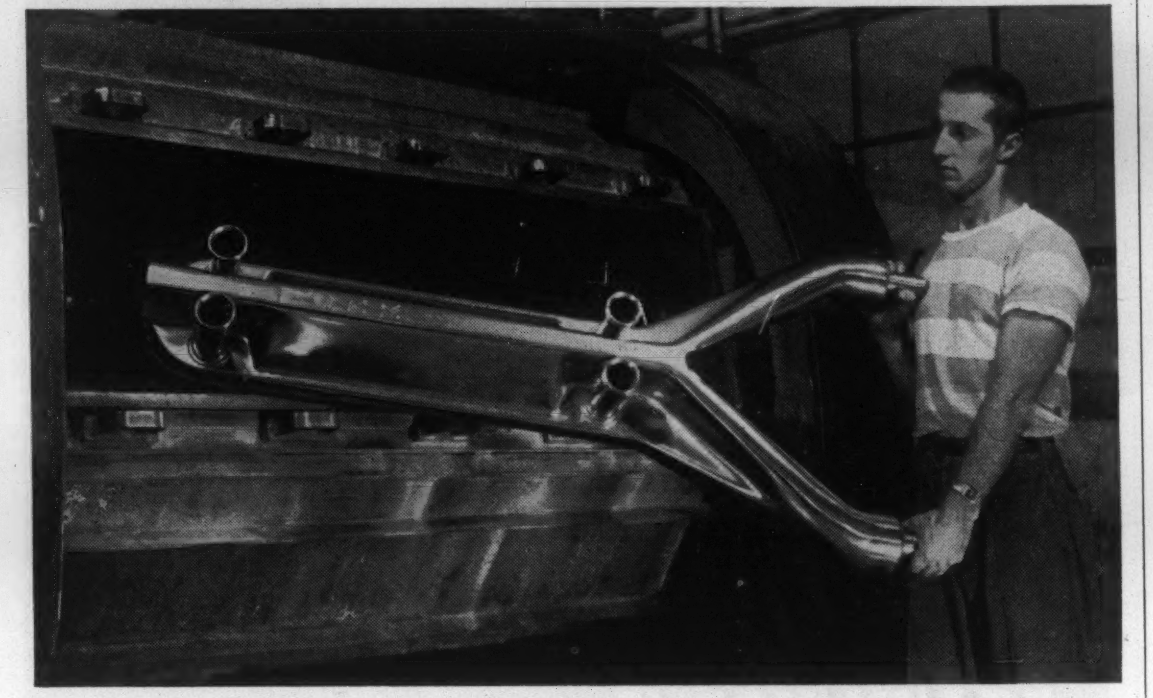
Company________________

Address________________

City________Zone____State______

For more information, turn to Reader Service Card, Circle No. 458

"40% INCREASE IN LUSTER AFTER USING LORCO COMPOUNDS"



Removing parts from the barrel, after tumbling with Lorco Chips and Compounds.

How an important Pennsylvania manufacturer saved money and solved an unusual barrel-finishing problem.

A large eastern corporation was exploring the possibilities of barrel-finishing stainless steel frames and heat exchanger units.

These frames, measuring 56" x 25", required specially designed fixtures to hold them in the barrel. The first try, according to the manufacturer, was a dismal failure. Numerous types of compounds and chips in varying combinations were experimented with, but none proved satisfactory and costs seemed prohibitive.

Finally, the only way they could do an acceptable job was to scrub the parts by hand with a brush and a soap detergent after tumbling. *And then they learned about LORCO COMPOUNDS!*

Using fused aluminum oxide chips and Lorco Compounds for 20 minutes, a load was washed down and the parts removed. Immediately it was apparent that the luster was greatly improved. Subsequent examination with a Gardner Glossmeter showed an increase in luster of 40% *over anything which had been previously tumbled.* In low costs, Lorco compounds were also winners . . . *39% under the costs of other compounds.*

If you have a tough barrel-finishing problem, be sure to try Lorco Chips and Compounds. Today they are offering truly amazing answers to the problems of scores of manufacturers . . . for thousands of parts . of all shapes and sizes. Write for detailed information about our free sample processing service and your copy of the new manual, "The Lorco Method of Precision Barrel Finishing."

Lorco

LORD CHEMICAL CORPORATION
2068 SOUTH QUEEN STREET YORK 4, PENNSYLVANIA

MANUFACTURERS OF BARREL FINISHING COMPOUNDS
TUMBLING BARRELS — MEDIA AND AUXILIARY EQUIPMENT

For more information, turn to Reader Service Card, Circle No. 427

speed of machining operations. Closer tolerances also can be held since normal heat and pressures generated in machining solid bar stock, do not occur in working hollow materials. Tests over long production runs reportedly indicate that the hollow aluminum bar stock has superior machining qualities for inside working tools, because the stock has the same cold worked properties on both the inside and outside surfaces.

Other advantages claimed over conventional solid screw machine stock include: higher strength (typical yield 52,000 psi), greater stability, less tooling, lower handling costs and a better surface for anodizing.

The stock is available in rounds of 1 through 2½ in. dia in 1/16-in. increments and 2⅝ through 3½ in. in ⅛-in. increments. Wall thicknesses for rounds vary from 0.109 to 0.500.

Epoxy Resin System Is Flexible Insulator

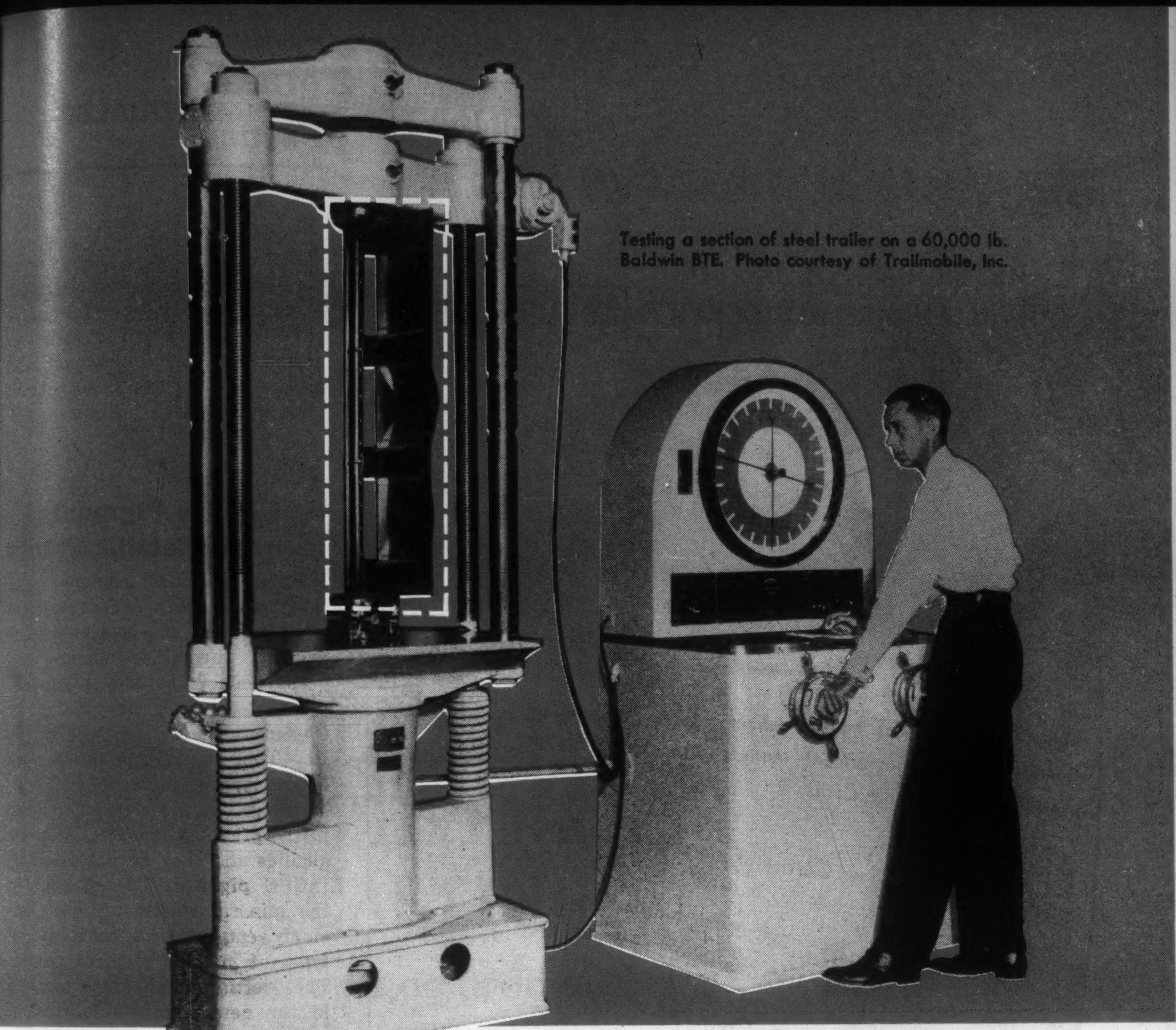
A modified epoxy resin system developed by *Furane Plastics, Inc.*, 4516 Brazil St., Los Angeles, is designed for electronic insulation applications requiring a semi-rigid, low modulus material that offers high electrical resistance from —65 F to at least 300 F. Called Epocast 15, it cures at moderate temperatures and is reported to combine good flexibility with outstanding properties as a dielectric material.

The material adheres to metals,

PROPERTIES OF EPOCAST 15

Dielectric constant	3.4
Loss factor at 110 kc	0.017
Loss factor at 1.0 mc	0.027
Loss factor at 11.0 mc	0.038
Volume resistivity at 300 F, microhm-cm	1.1×10^{10}
Elongation (tensile)	135%
Pot Life	3-4 da at 80 F
Cure	6 hr/200 F or 3 hr/250 F

For more information, Circle No. 570 ➤



Testing a section of steel trailer on a 60,000 lb. Baldwin BTE. Photo courtesy of Trailmobile, Inc.

get more for your money with a Baldwin BTE universal testing machine

This versatile machine stands ready to serve you in *two* ways. Ruggedly built, and virtually maintenance-free, it is ideal for heavy-duty production testing in your shop. Yet it is so accurate and reliable that it is ideal for high precision testing in your laboratory.

Six features that make the moderately-priced Baldwin BTE universal your best buy:

- Loading system is completely isolated from weighing system. Friction errors are eliminated.
- True null-balance system provides accuracy well within 0.5% of true load or 0.1% of load range.
- Range can be changed during test.
- Eccentric loading of full capacity 1″ off center affects accuracy less than 1% of reading or 0.2% of load range.
- 24″ multi-range masked dial indicator is illuminated by fluorescent light for easy reading.
- Stress cycling equipment, stress strain recorder, extensometer, load pacer and other accessories are available.

Baldwin BTE universals are built in capacities from 10,000 to 5,000,000 lbs. For bulletin 4401, write Dept. 1623, Electronics & Instrumentation Division, BLH Corporation, 806 Massachusetts Ave., Cambridge, Mass.

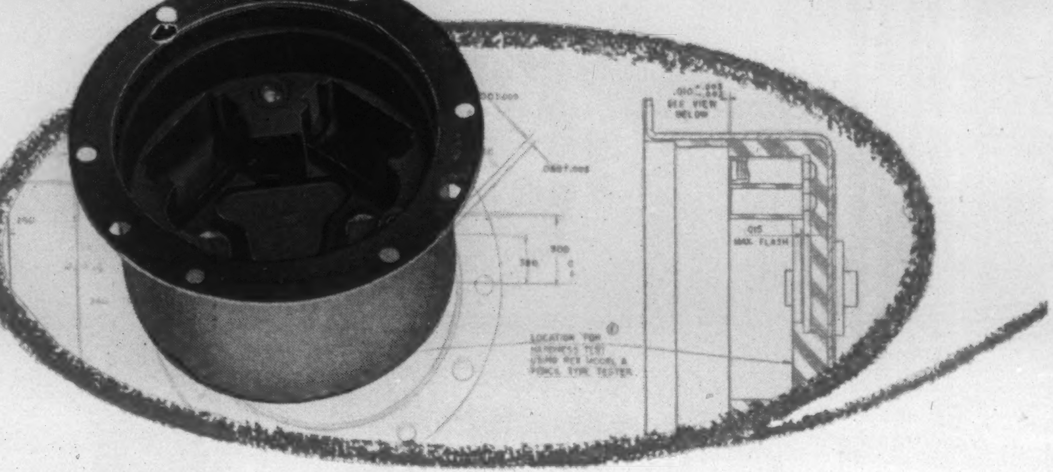
Be sure to see our new fatigue testing machine, new SR-4 universal and automatic programming equipment at the ASTM Show.
—*Frank Tatnall*

BALDWIN BLH LIMA-HAMILTON

ELECTRONICS & INSTRUMENTATION DIVISION
BALDWIN-LIMA-HAMILTON
DIVISIONS: Austin-Western • Eddystone • Hamilton • Lima • Electronics & Instrumentation • Loewy-Hydropress • Madsen • Pelton • Standard Steel Works

THE SHAPE OF THINGS IN MOLDED RUBBER

METER CASE MADE FOR
TOUGH AND READY SERVICE BY ACUSHNET



APPLICATION:
Ruggedized Case with molded rubber interior designed by famous electrical instrument manufacturer approved for use by the U. S. Signal Corps.

PROBLEM:
Mold and bond rubber to interior of metal case as shown. Hold dimensional tolerances to ± .010".
Hold dimensional tolerances from the flange to mount studs without distorting.

A. Clean metal case thoroughly without distorting.
B. Hold critical distances from the flange to mount studs as shown in the drawing.
C. Stud holes to be kept absolutely free of rubber.

SOLUTION:
Acushnet engineers decided to mold rubber to the flange which automatically compensated for depth tolerances. A one piece mold core provided with locating pins kept the stud holes free of rubber and aided in holding tolerances and producing the unusual contours wanted.

Acushnet is ready to serve you with technical assistance on your next molded rubber and bonded-to-metal part. "APCOTITE" bonding to metal of all polymers is an Acushnet exclusive. Send for brochure describing "APCOTITE" bonding in detail.

Specify "APCOTITE"!

Acushnet

ACUSHNET PROCESS COMPANY
NEW BEDFORD, MASSACHUSETTS
... Precision Molded RUBBER, SILICONES - "APCOTITE" BONDING

Address all communications to 750 Belleville Ave., New Bedford, Mass.

For more information, turn to Reader Service Card, Circle No. 461

OTHER NEW MATERIALS, PRODUCTS

ceramics and glass and is expected to be useful for electronic potting, impregnating and encapsulating. It is available as a two component clear impregnant and as a two component filled potting and encapsulating medium.

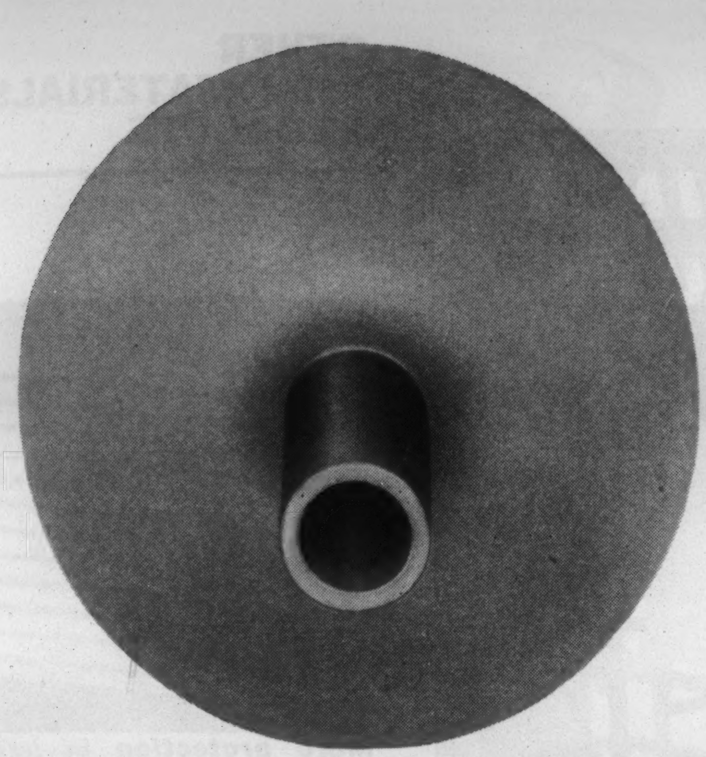
New Paste Pigments Improve Metallic Paints

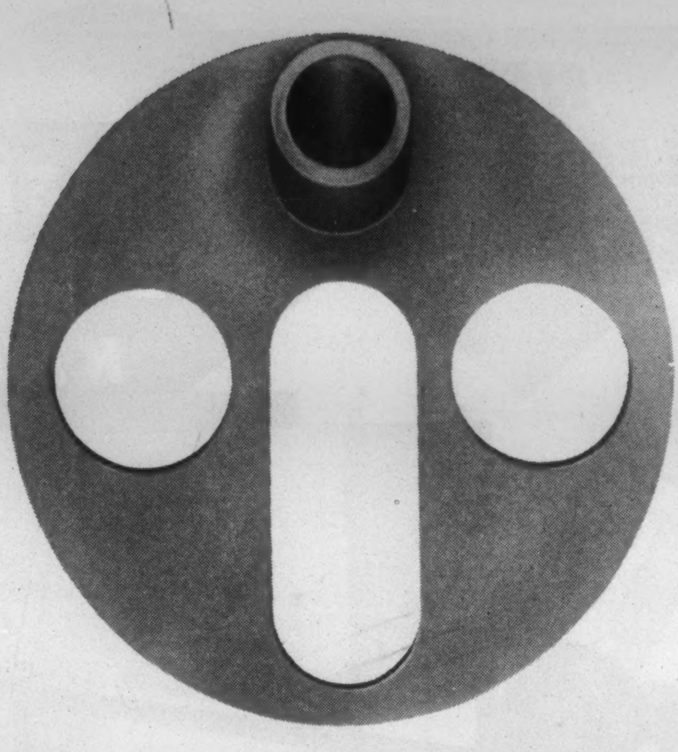
Paints, varnish, enamels and inks made with new multiple paste pigments are said to possess greater durability, luster and permanence. The new pigments, designated CPC, are made by *Chemical Sealers, Inc.*, Belleville, Ill. They are nonvolatile, nonhygroscopic, nonoxidizing and noncorrosive. They do not hydrolyze in the presence of water, acids or alkalies and they do not discolor.

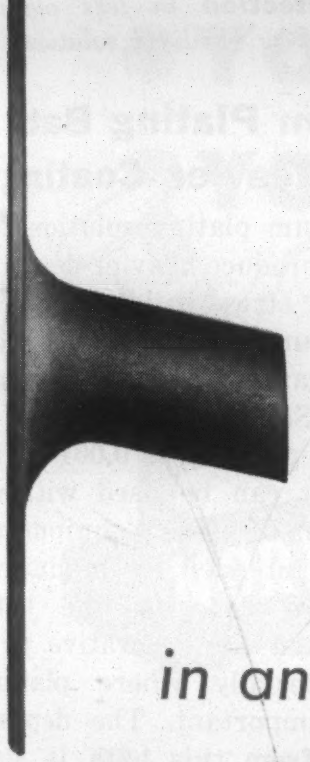
CPC pigments do not contain the mineral spirits or oils commonly employed in conventional types of metallic pigment pastes. The wetting agent incorporated in the new pigments lubricates, coats and polishes the metallic pigment flakes, and increases the surface tension of most conventional vehicles. The result is a more uniform dispersion of pigment causing accelerated leafing and producing a more tightly cemented metallic surface skin that is resistant to water, acids, alkalies, fungi, algae and salt water.

CPC pigments are claimed to be the first paste pigments of such metals as copper, bronze and even elemental iron that have practical applications. Among other metallic pigments being developed by the company are aluminum, silver, gold, lead, antimony, nickel, titanium, stainless steel, beryllium, tin, chromium, vanadium and tungsten. CPC pigments are also reported to form an ideal base for putty and caulking compounds, since they remain soft, plastic and usable indefinitely.

(Other New Materials on p 176)



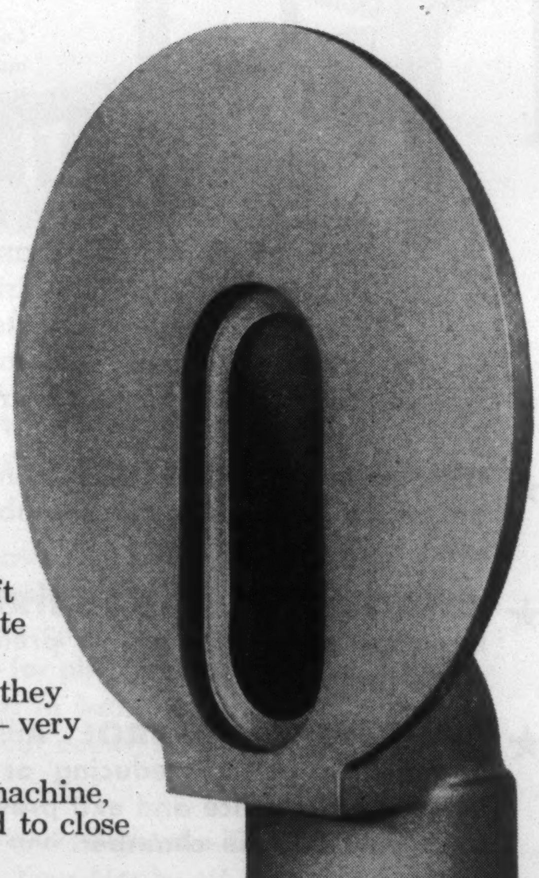




from Crucible

Aircraft Quality STAINLESS INVESTMENT CASTINGS

in any shape or grade . . .



Can your product benefit from the important features shown in these Crucible Accumet® precision investment stainless castings? They are tube supports for jet aircraft engine assemblies, but the characteristics they illustrate are just as vital to thousands of other applications.

THIN WALLS— Accurately produced by the Accumet casting process, they are impossible to make in sand or shell mold castings — very difficult to forge.

BLIND HOLES— like this one, are impossible to forge, expensive to machine, and very difficult to sand cast . . . but they can be held to close tolerances by Accumet casting.

CORING— Deep or intricate cores — prohibitively costly to machine — can be economically produced by the Accumet process.

ODD SHAPED PARTS— difficult to chuck and machine, are economical when they're Accumet castings.

Next time your designs call for parts with intricate shapes . . . close tolerances . . . fine finish . . . high quality and uniformity, make them Crucible Accumet castings. They are available in any grade of steel or high alloy your product calls for. Let a Crucible engineer give you all the facts about how Accumet castings can save you time and money. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

Write for a free copy of the informative folder "Accumet Castings".

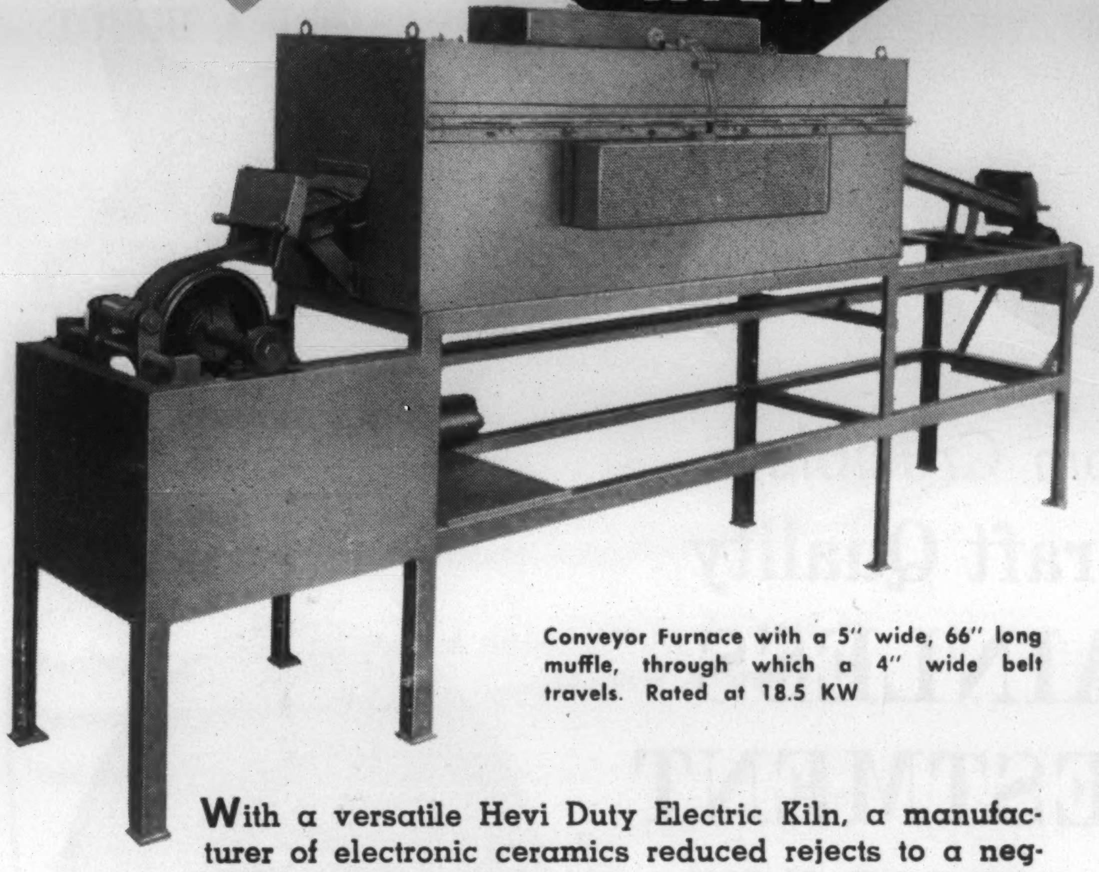
CRUCIBLE **first name in special purpose steels**

Crucible Steel Company of America

• For more information, turn to Reader Service Card, Circle No. 548

NEW ELECTRONIC CERAMICS

FIRED IN A HEVI DUTY KILN



Conveyor Furnace with a 5" wide, 66" long muffle, through which a 4" wide belt travels. Rated at 18.5 KW

With a versatile Hevi Duty Electric Kiln, a manufacturer of electronic ceramics reduced rejects to a negligible amount. The firing of Titanate parts, cement coatings, printed circuits and ceramic capacitors and resistors is easily accomplished because the Hevi Duty Kiln offers these advantages:

★ **UNIFORM TEMPERATURE** Long life heating units are placed on all sides of the work chamber assuring rapid heating and even heat distribution.

★ **ZONE TEMPERATURE CONTROL** provides accurate temperatures for critical firings. A preheat and cooling chamber prevents thermal shock.

★ **ATMOSPHERE CONTROL** An alloy muffled heating chamber permits the use of reducing or special atmospheres. Curtain burners at entrance and exit prevent contaminating atmospheres from entering the chamber.

★ **VARIABLE SPEED DRIVE** The drive mechanism which is within easy reach of the operator, regulates conveyor speed for required time cycles.

★ **MESH BELT CONVEYOR** allows volume production with a minimum of material handling and provides extra versatility by conveying parts of various sizes and shapes.

★ **EFFICIENCY** Sturdy construction with ample layers of insulation assures low operating and maintenance costs.

SPECIAL HEVI DUTY ELECTRIC KILNS can be engineered to coordinate with production systems. Send us your specifications.

HEVI DUTY ELECTRIC COMPANY

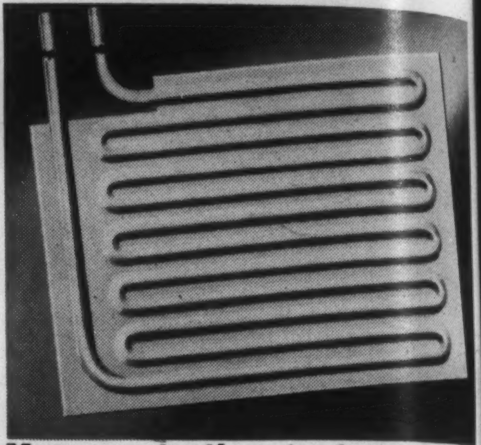
MILWAUKEE 1, WISCONSIN

Heat Treating Furnaces... Electric Exclusively

Dry Type Transformers *Constant Current Regulators*

For more information, turn to Reader Service Card, Circle No. 457

OTHER NEW MATERIALS, PRODUCTS



More protection *in less plating time with new rhodium solution.*

Rhodium Plating Bath Gives Heavier Coatings

A rhodium plating solution designed to produce heavier deposits with lower stress in less time has been announced by *Baker & Co., Inc.*, Newark, N. J. Known as Rhodium Solution No. 221, it is claimed to plate up to 0.001 in. in 70 min. It can be used without modification of present equipment.

Though intended for producing specification deposits, the bath may be used for decorative purposes, especially where plating speed is important. The deposit produced from this bath is also useful in many electrical and electronic applications. It is said to assure low noise level for moving contacts, low and stable contact resistance, and no oxide rectification. Plated over nickel or silver, rhodium provides protection for printed circuits.

Airfoil Shaped Strip Is Smooth, Accurate

Airfoil strip reportedly produced to close tolerances with excellent finishes has been developed by *General Plate Div., Metals & Control Corp.*, Attleboro, Mass. This profile-rolled material is said to be finding wide use as stator blades for jet engine compressors and in other turbine type applications such as hydraulic torque converters. Here, the surface

●YOU PLATE METAL
●YOU PAINT METAL
●YOU WELD ALUMINUM
●YOU STRIP ORGANIC FINISHES

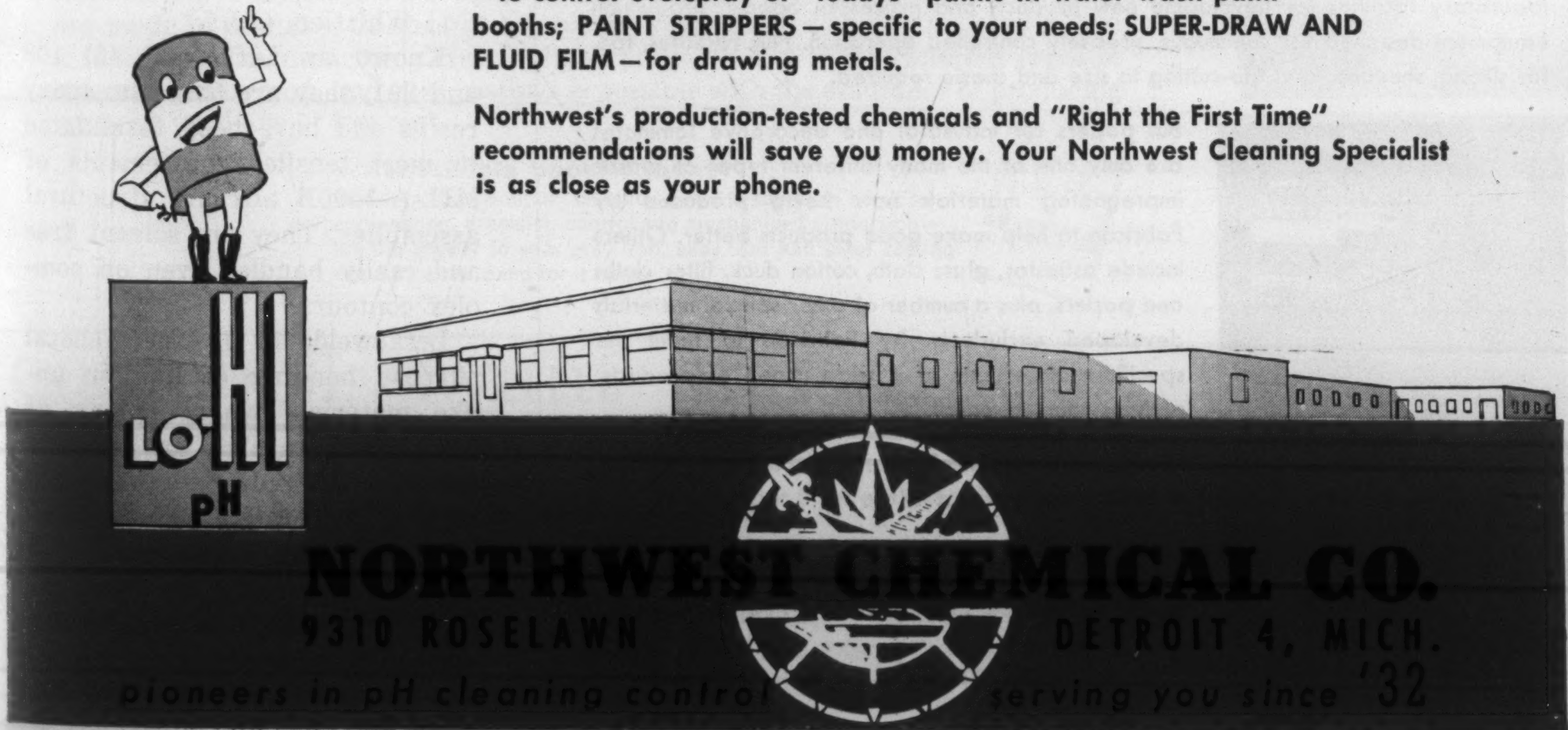
NORTHWEST'S CHEMICALS DO IT BETTER!

Northwest's years of research in formulating and perfecting analytically correct, job-adjusted cleaners are your assurance of the right chemical for your job.

Northwest's Metal Cleaning Specialists have at their command such outstanding processes as LO HI pH — for cleaning prior to plating, painting or vitreous enameling; ALKALUME — for preparing aluminum for finishing and spot welding; INTERLOX — for phosphate coating; SPRA-LUBE — to control overspray of "todays" paints in water-wash paint booths; PAINT STRIPPERS — specific to your needs; SUPER-DRAW AND FLUID FILM — for drawing metals.

Northwest's production-tested chemicals and "Right the First Time" recommendations will save you money. Your Northwest Cleaning Specialist is as close as your phone.

Remember — YOUR COST PER FINISHED ARTICLE IS THE TRUE COST OF YOUR CLEANER



NORTHWEST CHEMICAL CO.
9310 ROSELAWN DETROIT 4, MICH.
pioneers in pH cleaning control *serving you since '32*

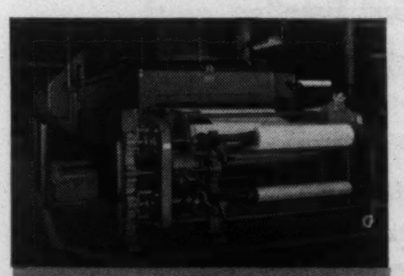
For more information, turn to Reader Service Card, Circle No. 416

From Table Tops
to TV Sets

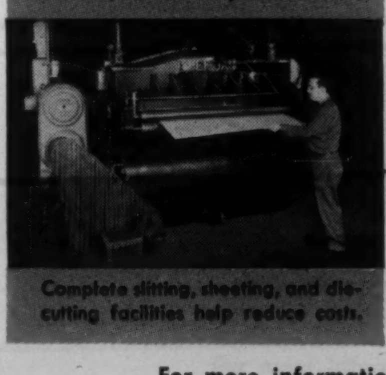
Fabricon Plastic Impregnated Materials help MAKE GOOD PRODUCTS BETTER!

When it comes to plastic impregnated papers for laminating or molding applications, you'll do well . . . *always* . . . to think of Fabricon *first!* First for melamine impregnated patterns, wood grains, solid colors, and translucent overlays for durable decorative laminates. And first, too, for phenolic impregnated N.E.M.A. industrial grades for countless electrical, mechanical and structural uses.

Yes, regardless of what your requirements are for plastic impregnated papers, you'll find that Fabricon has what it takes to deliver the quality and service you're looking for. Years of experience with all types of thermosetting resins and fillers. Complete laboratory facilities for developing new products and processes. Special production equipment designed for continuous, precisely controlled operation. Plus facilities, too, for slitting, sheeting, and die-cutting to size and shape required.



Giant impregnating ovens having roll capacities up to 90" in width assure efficient, economical production.



Complete slitting, sheeting, and die-cutting facilities help reduce costs.

But papers for industrial and decorative laminates are only one of the many different types of plastic impregnated materials now being produced by Fabricon to help make good products better. Others include asbestos, glass cloth, cotton duck, filter cloths and papers, plus a number of other special materials developed exclusively by Fabricon to fulfill the specific requirements of a wide range of products, *perhaps yours included!*

Want more detailed information on Fabricon products, facilities, and services? Write for it today!

FABRICON PRODUCTS
A Division of The EAGLE-PICHER Company
1721 W. PLEASANT STREET
RIVER ROUGE 18, MICHIGAN

Reinforced Plastic Moldings • Plastic Impregnated and Coated Materials

For more information, turn to Reader Service Card, Circle No. 555

OTHER NEW MATERIALS, PRODUCTS

polishing is omitted since the as rolled finish is adequate for most hydraulic purposes.

The strip is available in continuous coils, random lengths and straight lengths (stretcher leveled up to 6 ft); in widths up to 1.5 ±0.006 in. and 2.5 ±0.009 in.; and in thicknesses up to 0.300 in. The rolled finish, not more than 40 microin. rms, is adequate for most hydraulic applications. The strip is also available polished to 20-25 microin. or buffed to a finish of no greater than 16 microin.

Metals used to produce the vane material are Type 410 stainless steel, Ascoloy, low carbon steel, brass, aluminum and titanium.

New Adhesives Bond Diverse Materials

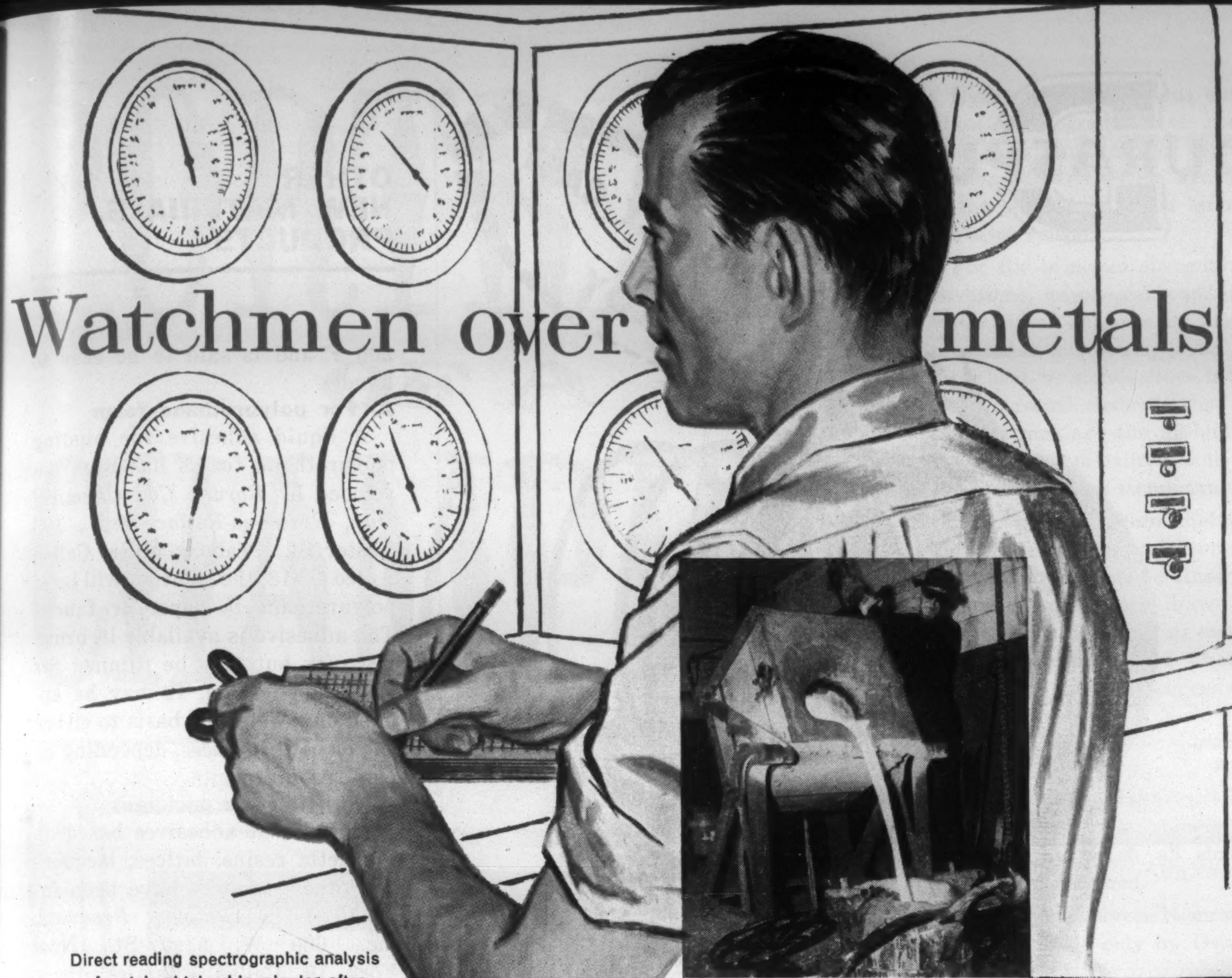
Five recent developments in adhesives for rigid materials, plastics foams and laminates, and packaging films are described below.

1. For rigid materials

Three structural adhesives for general and special purpose bonding of rigid materials, such as metals, glass, ceramics, hard rubber and plastics, have been announced by *Leffingwell Chemical Co.*, Whittier, Calif.

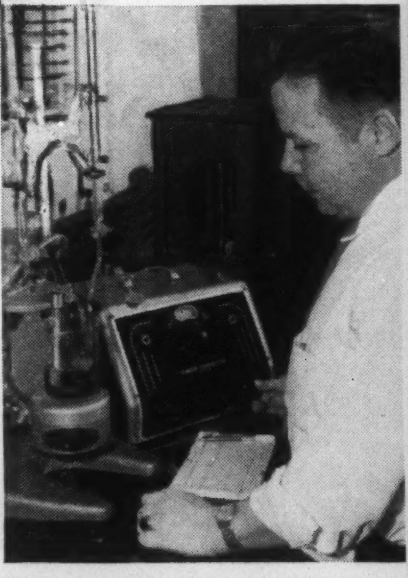
Known as Lefkoweld 46, 108 and 201, they are based on epoxy resins and have been formulated to meet tensile requirements of MIL-A-5090B aircraft structural assemblies. They are solvent free and easily handled even on complex contours.

Lefkoweld 46 is for general purpose bonding of like or unlike materials where curing at room temperatures or slightly above is desired. Lefkoweld 108 cures at moderately elevated temperatures and maintains full strength from dry ice temperatures to 200 F. It is suitable for intermittent use without degradation up to 400 F. Lefkoweld 201 gives high bonding strengths at



Direct reading spectrographic analysis of metals obtained in minutes after being tapped from cupola or furnace.

Test heat of special alloy iron being poured in experimental laboratory.



Both raw materials and finished castings are given chemical tests to assure conformance to specifications.

Latest Technological Advances Help Maintain Precision Control Over CWC Castings

Precision control of the composition, finish, and properties of CWC castings is made possible by means of careful testing methods, thorough inspection and advanced metallurgical engineering. Metals are checked in the CWC special test foundry, radiographs are made by the million volt X-ray machine, analyses are made in minutes. Control at Campbell, Wyant and Cannon is as important a function as manufacture. Thus, volume production of many different types of grey iron, alloy iron, and steel castings is possible with the assurance of producing superior products at low cost.

Write for this booklet today!

Booklet, "One Source" tells how CWC's complete services—engineering, precision control and mechanized production—are the answer to your grey iron, alloy iron and steel casting requirements. Send for it now!

campbell, wyant and cannon

FOUNDRY COMPANY

A Division of Textron Inc.

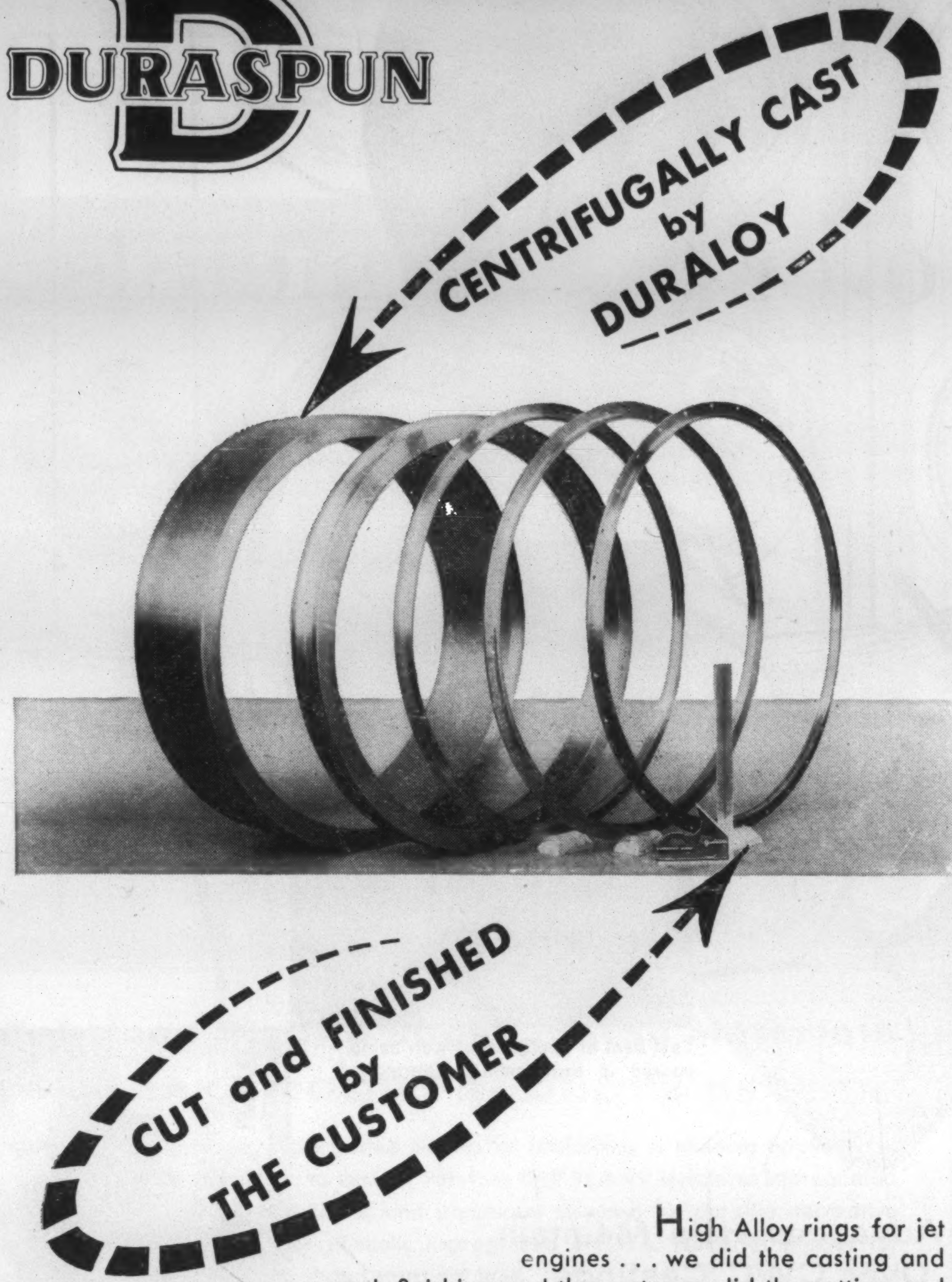
MUSKEGON, MICHIGAN

CWC

SIX FOUNDRIES LOCATED IN MUSKEGON, LANSING AND SOUTH HAVEN, MICHIGAN . . . READY TO SERVE YOU.

For more information, turn to Reader Service Card, Circle No. 530

DURASPUN



High Alloy rings for jet engines . . . we did the casting and rough finishing and the customer did the cutting and final finishing.

Centrifugally cast metal gives an exceptionally fine, dense, uniform grain structure. The strength of the metal approaches that imparted to a bar or ingot when it is hot forged. It produces an ideal metal for the tough service required of jet engine parts.

Incidentally, as evidence of our knowledge of and experience with tough alloy castings — static as well as centrifugal — the records show very few rejections by this engine manufacturer who subjected each of the many rings we furnished to his own very rigid tests.

May we suggest that you let Duraloy work on your high alloy castings — chrome iron, chrome nickel or nickel chrome? We have the experience and facilities for turning out high quality castings.

THE DURALOY COMPANY
Office and Plant: Scottdale, Pa. • Eastern Office: 12 East 41st Street, New York 17, N.Y.
Detroit Office: 23906 Woodward Avenue • Pleasant Ridge, Mich.
Atlanta: J. M. TULL Metal & Supply Co.
Chicago: F. O. NELSON 332 S. Michigan Avenue
METAL GOODS CORP.: Dallas • Denver • Houston • Kansas City • New Orleans • St. Louis • Tulsa

For more information, turn to Reader Service Card, Circle No. 394

OTHER NEW MATERIALS, PRODUCTS

200 F and is said to be easy to handle.

2. For polyurethane foam

A liquid adhesive for binding polyurethane foams has been developed by *Borden Co., Chemical Div., Resinous-Reslac Dept.*, 103 Foster St., Peabody Mass. Called Arcco C 518, the solution will bond polyurethane to paper or fabric. The adhesive is available in brush viscosity but may be thinned for spray application. It may be applied on a wet-stick basis to either one or both surfaces, depending on bond requirements.

3. For plastics packages

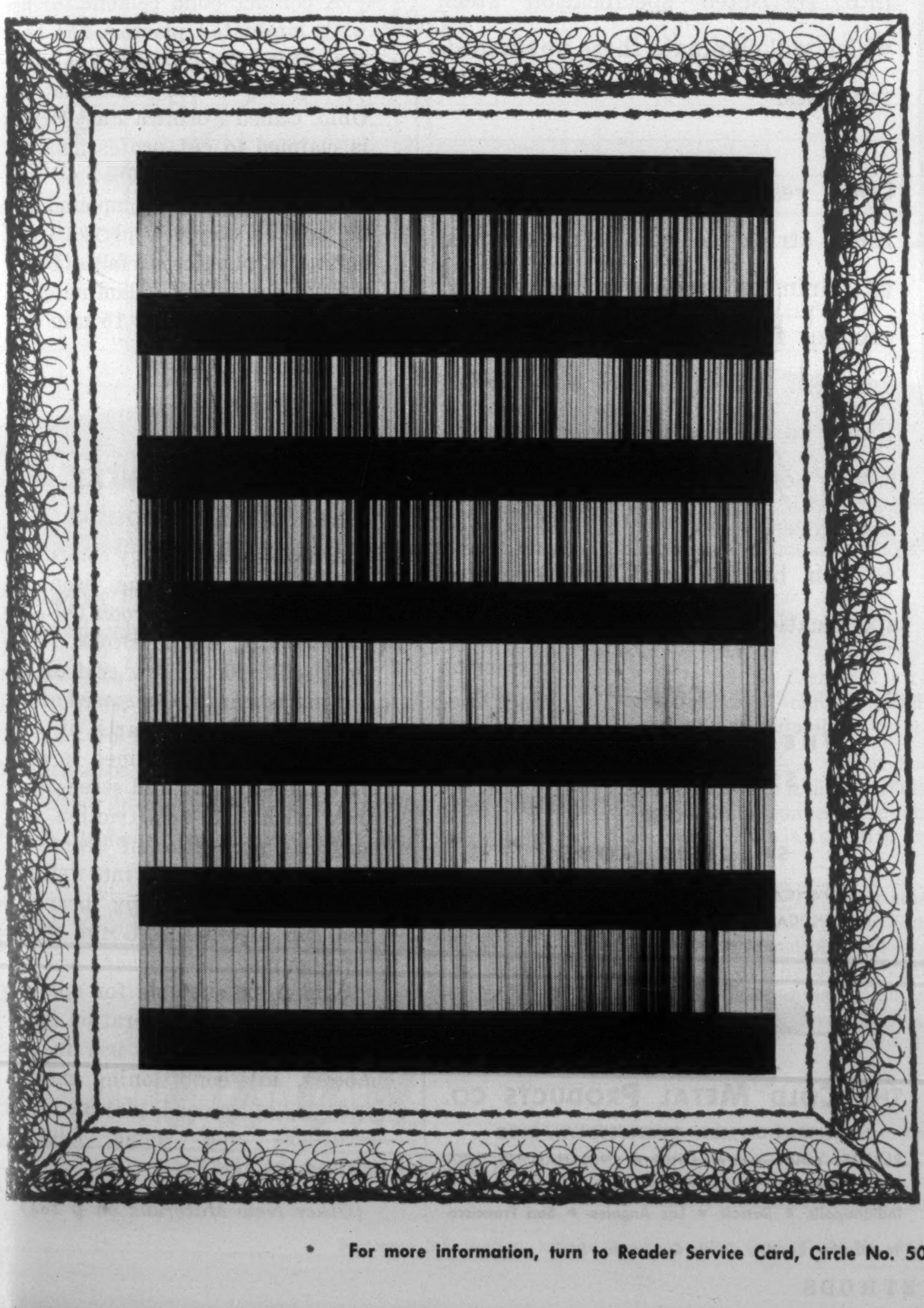
A series of adhesives based on synthetic resins, latices, lacquers and other organics have been introduced by *Paisley Products, Inc.*, 630 W. 51st St., New York 19. Called Pliastics, these adhesives have been formulated for plastics used in the packaging industry.

Pliastic-241, the most versatile in the series, is built around synthetic latices. It is recommended for surface treated polyethylene, Mylar and heavily waxed glassines. Pliastic-242 and 243 are of heavier viscosity than 241. Pliastic-7051 also has a latex base, but is suitable for work with Pliofilm. Pliastic-1707 is formulated for adhering paper labels to lacquered, varnished, printed or metal containers, plastics bottles or closures, and plated metals. Pliastic-5515 is a polyvinyl acetate type adhesive used with cellulose acetate, polystyrene, Saran, and cellophane packages. Pliastic-8423 is a lacquer type adhesive, specially compounded for Mylar. Also developed by Paisley are two carbohydrate-base materials, 6718 and 6722, used on silicone coated bottles.

4. For printed circuits

High solder temperature resistance is claimed for an adhesive developed by *Houghton Laboratories, Inc.*, Olean, N. Y., for printed circuits. Called Hysol

PORTRAIT OF A CHAMPION



Nichrome*, the famous alloy whose spectrogram you see here, is as truly a masterpiece as any Rembrandt or DaVinci hanging in the galleries—and for largely the same reason.

For the principal elements in Nichrome, *anyone* can combine. What gives Nichrome its unapproachable superiority over all other heat-resistance alloys, is the truly personal elements that go into its making—the all-important, highly specialized skills of the Driver-Harris technicians.

Step-by-step from melting through every processing operation, from furnace to finished spools of wire (some drawn as fine as .0005 dia.) exacting metallurgical controls and checks operate to assure the peerless and enduring qualitites of Nichrome. These quality controls represent 58 years of continuous alloy research that have established Nichrome as the time-tested standard by which all similar alloys are measured.

Yes, there is only one Nichrome, and it is made only by Driver-Harris.

And in recognition of its unique properties, the United States Patent Office in August, 1908, granted solely and exclusively to us the trade-mark NICHROME.

*T. M. Reg. U. S. Pat. Off.

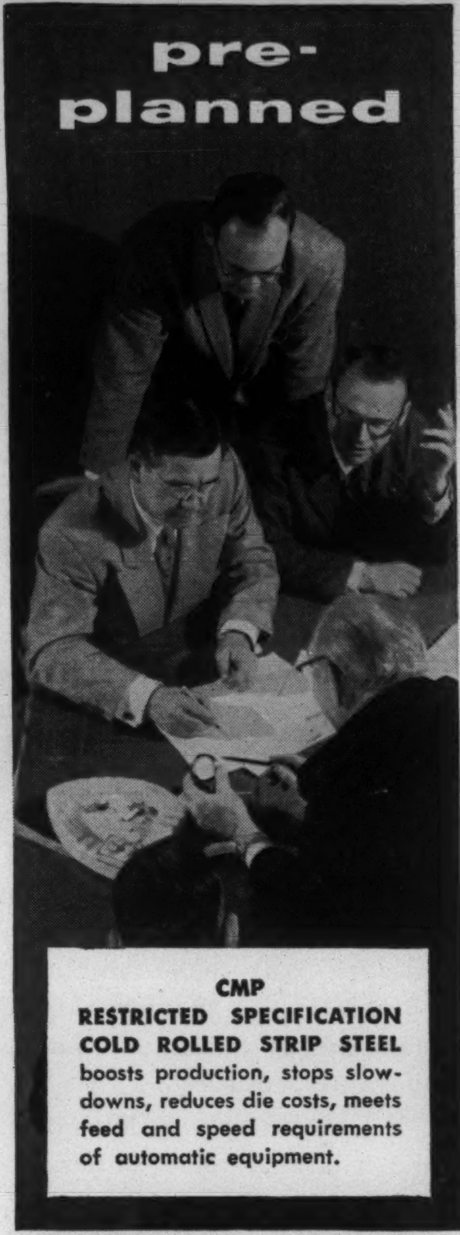
SPECIAL PURPOSE ALLOYS SINCE 1899
D/H
TRADE MARK REG. U. S. PAT. OFF.

Driver-Harris*
COMPANY
HARRISON, NEW JERSEY

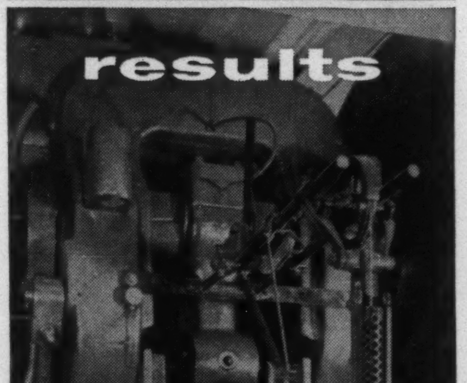
BRANCHES: Chicago, Detroit, Cleveland, Louisville, Los Angeles, San Francisco • In Canada: The B. GREENING WIRE COMPANY, Ltd., Hamilton, Ontario

MAKERS OF THE MOST COMPLETE LINE OF ELECTRIC HEATING, RESISTANCE, AND ELECTRONIC ALLOYS IN THE WORLD

For more information, turn to Reader Service Card, Circle No. 509



CMP
RESTRICTED SPECIFICATION COLD ROLLED STRIP STEEL
boosts production, stops slowdowns, reduces die costs, meets feed and speed requirements of automatic equipment.



CMP STRIP PROVIDES
the precision dimensional and physical qualities that solve many fabrication, cost and performance problems.

In estimating production costs, one of the items a metal fabricator takes into account is the cost of steel. As important as this is, it is sometimes good economics to pay more for steel, but pay less in the end for the fabricated part. The cost of down time on expensive forming equipment, the cost of idle labor, the cost of reprocessing defective parts, may well exceed the cost of the extras built into restricted specification steel, which will eliminate these unplanned-for costs.

CMP restricted specification cold rolled strip steel can be pre-planned to minimize production delays and produce for you the production cost you need. We will welcome the opportunity to explore with you the cost-saving potentials in your manufacturing processes which may be available to you by use of **CMP** restricted specification cold rolled strip steel.

CMP
WHERE YOU CAN GET SPECIFIC SPECS FOR SPECIFIC JOBS
LOW CARBON, ELECTRO ZINC COATED, HIGH CARBON, TEMPERED SPRING STEEL, STAINLESS AND ALLOY

C M P

THE COLD METAL PRODUCTS CO.
GENERAL OFFICES: YOUNGSTOWN, OHIO
PLANTS: YOUNGTOWN, OHIO & INDIANAPOLIS, IND.
SALES OFFICES: New York • Cleveland • Chicago
Indianapolis • Detroit • Los Angeles • San Francisco

For more information, turn to Reader Service Card, Circle No. 395

OTHER NEW MATERIALS, PRODUCTS

2217, it is a modified rubber phenolic adhesive supplied as a one component, low viscosity (600 cps) liquid. Dip solder resistance varies from 10 to 30 sec at 500 F.

Peel strengths of 12 to 17 lb per in. have been obtained, depending on type and thickness of the copper used. According to Houghton, the adhesive coated copper can be stored for at least six months without danger to bond uniformity or loss of bond strength.

5. For laminated plastics

A contact bond cement for use with laminated plastics has been announced by *Formica Co.*, 4620 Spring Grove Ave., Cincinnati 32, Ohio. Called Formica Fast Dry, it is claimed to cut professional installation time by 30%.

The clear smooth compound may be applied to both plywood and laminated plastics surfaces. Under normal conditions a laminate can be applied after only 15 min drying time.

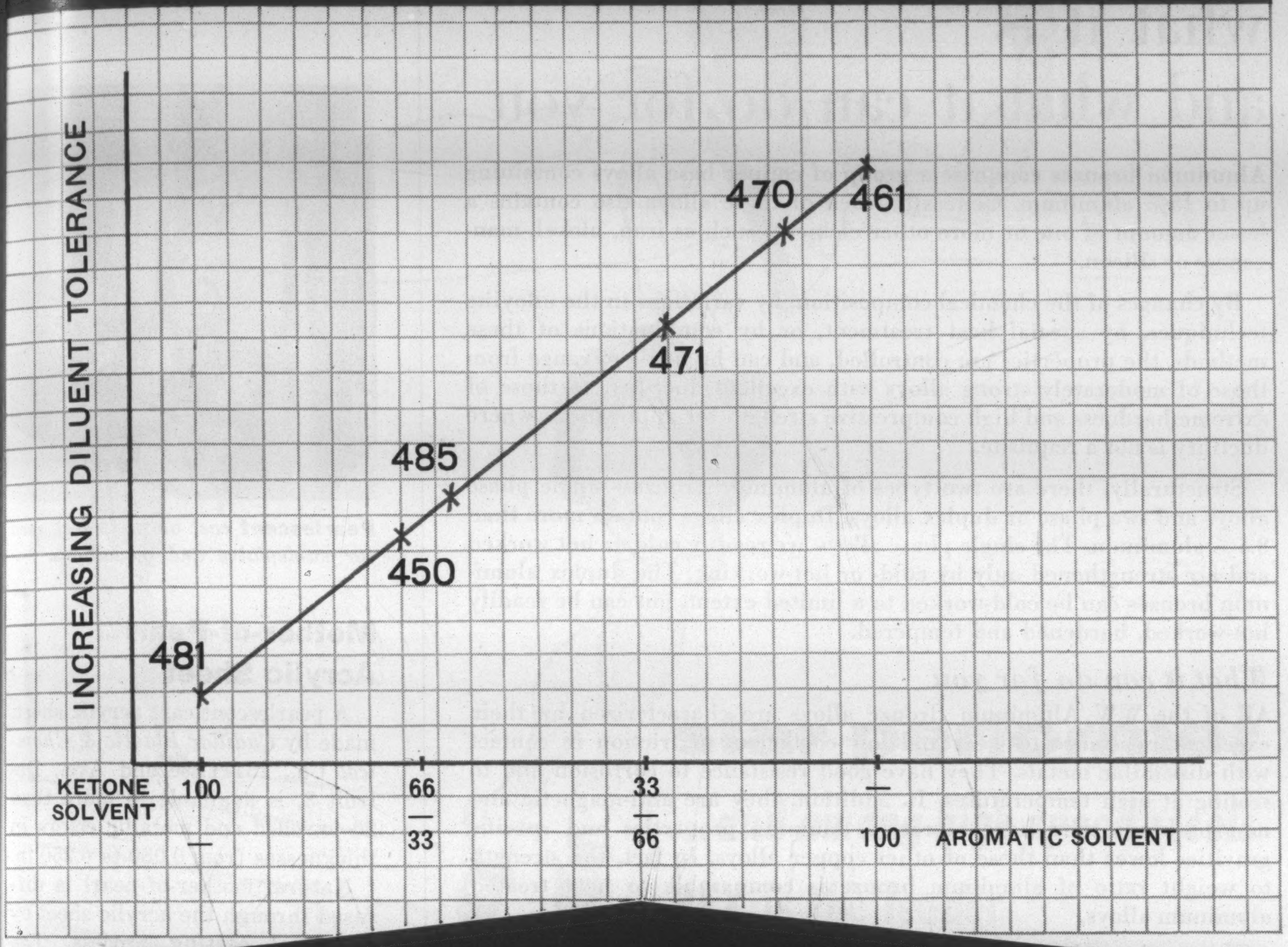
Powder Metallurgy Bearing Compound

A powder metallurgy compound, called Compo E, has been developed by *Bound Brook Oil-Less Bearing Co.*, Bound Brook, N. J., for production of low cost oil retaining bearings. Composed of approximately equal parts of iron and bronze, it is claimed to combine the economy and strength of iron with the anti-friction and long life properties of bronze. It can be fabricated into sleeve, flange or self-aligning bearings and can also be used for structural parts.

Said to be suitable for applications where quiet operation is essential, it is finding use in fan motors, air conditioning motors and drives, record players, tape recorders and home laundry equipment.

(Other New Materials on p 184)

EXON SOLUTION RESINS—VINYL CHLORIDE TYPE



Pick your proper solution resin...*at a glance!*

- Another Firestone service to help you make the right resin choice!

These 6 EXON solution resins are engineered precisely, varying in properties to suit various applications and uses—but never varying in quality of performance.

Further product details at right. Keep this chart handy to help you choose easily and accurately.

EXON 450—Ideal for strip coatings. Good solubility, tensile strength and durability.

EXON 461 — A unique fluorine-containing resin combining high solubility, unusual chemical resistance, heat stability and weatherability.

EXON 470 — Excellent adhesion to metals, alkyd and vinyl surfaces. Compatible with wide range of drying oils, alkyds, phenolics, melamines. High solubility in inexpensive solvents.

EXON 471 — Excellent for weatherability and durability in a protective coating. Corrosion resistant. No measurable change after sunlamp exposure for 360 hours as 1 mil film.

EXON 481 — Makes possible colorful, abrasion-proof, washable coatings that resist fading or cracking.

EXON 485—For superior strip coatings. Lower viscosity makes application easier and shelf-life better. Good clarity.

Firestone

EXON®

For complete information and technical service, call or write:

CHEMICAL SALES DIVISION

FIRESTONE PLASTICS COMPANY, DEPT. 63H POTTSTOWN, PA. • A DIVISION OF THE FIRESTONE TIRE AND RUBBER COMPANY

• **For more information, turn to Reader Service Card, Circle No. 466**

WW Aluminum Bronze—what it is and what it can do for you

Aluminum bronzes comprise a group of copper base alloys containing up to 15% aluminum. Generally, each of these alloys also contains a lesser amount of one or more other elements such as iron, nickel, manganese or silicon.

By changes of the chemical composition, by variations in the alloying techniques, by special heat treatment, or by combinations of these methods, the properties are controlled, and can be made to range from those of moderately strong alloys with excellent ductility, to those of extreme hardness and high compressive strength for applications where ductility is not a requisite.

Structurally, there are two types of aluminum bronzes—single phase alloys and two phase or duplex alloys. Duplex alloys contain more than 8.5% aluminum. The single phase alloys are readily cold or hot worked and are strengthened only by cold- or hot-working. The duplex aluminum bronzes can be cold-worked to a limited extent, but can be readily hot-worked, hardened and tempered.

What it can do for you

All of the WW Aluminum Bronze alloys are characterized by their excellent resistance to wear and low coefficient of friction in contact with dissimilar metals. They have good resistance to corrosion and to scaling at high temperatures. In addition, they are anti-magnetic and non-sparking; they have vibration damping properties and specific gravities lower than those of other copper alloys. In fact, the strength to weight ratio of aluminum bronze is comparable to heat treated aluminum alloys.

These unique characteristics make aluminum bronze important to the product designer in the following typical applications:

Wear Resistance—bearings, bushings, machine tool parts, forming and drawing dies, wear plates, gears, cams, worm wheels, slides, guides, etc.

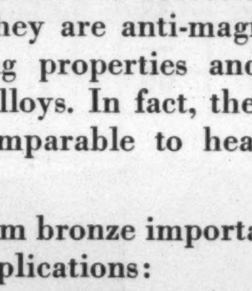
Corrosion Resistance—heat exchanger equipment, cylinder heads, pump parts, pickling equipment, autoclaves, valve sleeves, marine parts, etc.

Non-Magnetic—electrical parts, instrument housings, aircraft and marine parts, etc.

Non-Sparking—tools: hammers, sledges, saws, wrenches, crowbars, picks, shovels, etc.

WW Alloys maintains its own foundry and forging facilities for *premium quality* centrifugal, sand, permanent mold castings to your specifications. Parts can be furnished partly or finish machined, ready for use.

Write now for our 32-page bulletin "WW Aluminum Bronzes," containing a comprehensive description of the alloy group, engineering data and specifications for individual alloys, drawings, tables of machining recommendations.



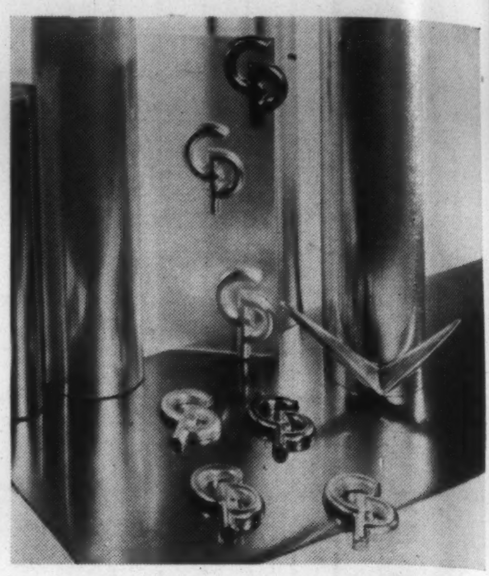
WW ALLOYS, INC.

11695 CLOVERDALE AVE.
DETROIT 4, MICHIGAN

Division of Fansteel Metallurgical Corporation

For more information, turn to Reader Service Card, Circle No. 439

OTHER NEW MATERIALS, PRODUCTS



***Pearlescent** cast acrylic sheet used for nameplates and medallions.*

Mother-of-Pearl Acrylic Sheet

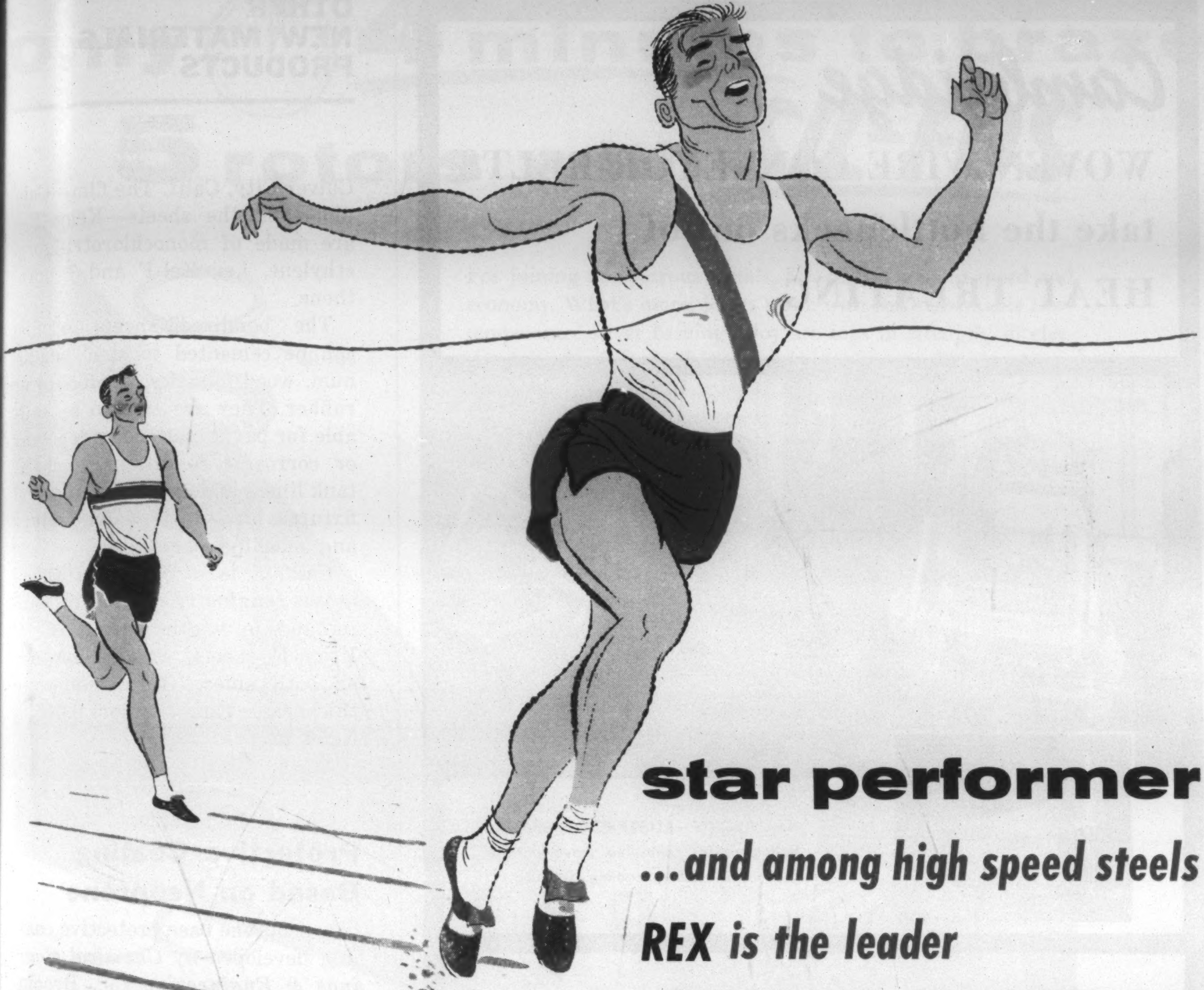
A pearlescent cast acrylic sheet, made by *Cadillac Plastic & Chemical Co.*, 15111 Second Ave., Detroit 3, is available in more than 20 jewelled and metallic colors in thicknesses from 0.080 to 0.250 in.

Natural mother-of-pearl is diffused through the acrylic sheet by a special casting process. The sheet, said to have exceptionally high luster and color penetration, is easily machined and formed without affecting the orientation of the pearl. It has excellent tensile and flexural strength, is shatter- and impact-resistant and dimensionally stable. It is also claimed to be an excellent thermal and dielectric insulator. Sheet sizes range from 12x48 in. to 36x48 in.

The material is expected to find application in automobile and refrigerator nameplates and medallions, emblems, appliance knobs and plaques.

Easily Bonded Fluorocarbon Sheets

Fluorocarbon film and sheets that can be readily bonded with conventional adhesives are being marketed by *Shamban Engineering Co.*, 11617 W. Jefferson Blvd.,



star performer

...and among high speed steels REX is the leader

Crucible REX® high speed steel has been the winner in shop tests for more than fifty years. *And now REX is even better than ever!* For Crucible research and experience has led to improved manufacturing techniques that mean higher quality – greater uniformity.

Prove the superiority of REX for yourself – on your next job. Check it for size, structure, response to heat treatment, all-around tool performance. Then you'll know why REX has always been the *standard by which other high speed steels are compared.*

REX is immediately available at all of Crucible's convenient warehouses – or through prompt mill delivery. For a list of available data on REX and other Crucible *special steels,* write for a free copy of the "Crucible Publication Catalog". *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

CRUCIBLE first name in special purpose steels

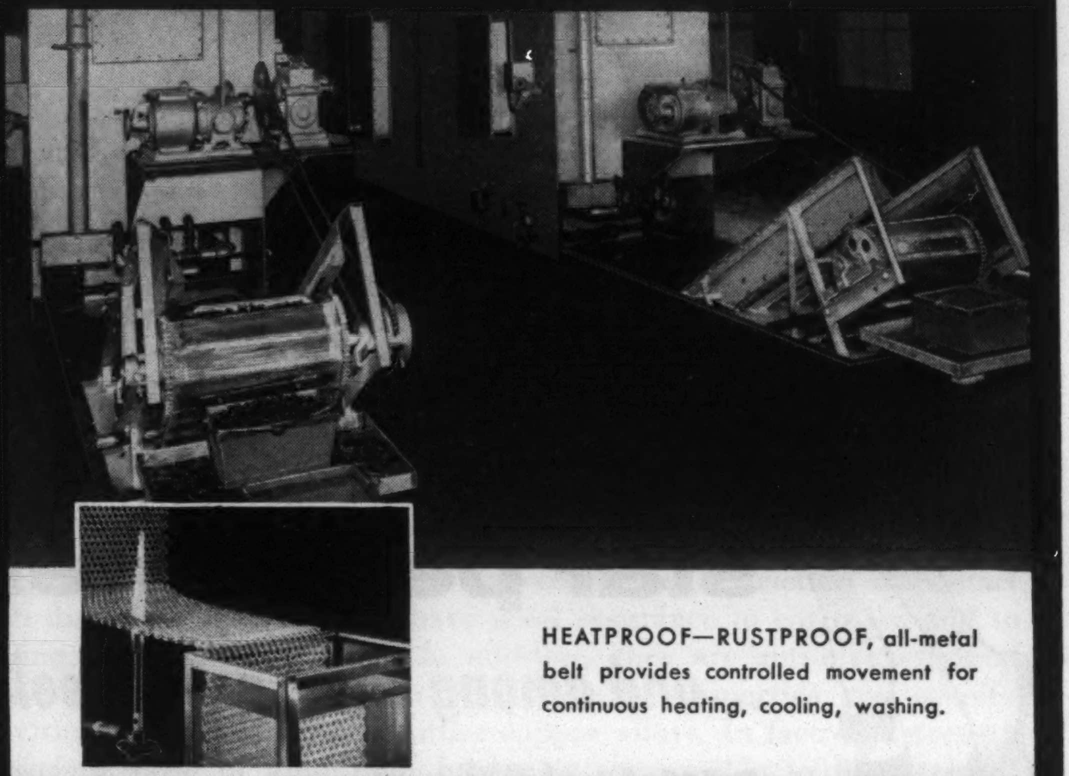
Crucible Steel Company of America

Canadian Distributor – Railway & Power Engineering Corp., Ltd.

* For more information, turn to Reader Service Card, Circle No. 378

Cambridge

WOVEN WIRE CONVEYOR BELTS take the bottlenecks out of HEAT TREATING



HEATPROOF—RUSTPROOF, all-metal belt provides controlled movement for continuous heating, cooling, washing.

By combining movement with processing, Cambridge Woven Wire Conveyor Belts completely eliminate profit-stealing batch handling. Continuous, belt-to-belt flow through annealing and tempering furnaces, quenching and pickling baths, and wash sprays cuts costs and provides continuous uniform production.

All-metal belt is corrosion resistant and impervious to heat damage at temperatures up to 2100°F. Open mesh construction allows heat and gases to circulate freely all around the work and provides rapid drainage of process solutions. Cambridge belts have no seams, lacers or fasteners to wear more rapidly than the body of the belt . . . no localized weakening. Cambridge Woven Wire Belts for heat treating are made in any size, mesh or weave, and from any metal or alloy. Special retaining edges or cross-mounted flights are available to hold your product during inclined movement.

Call in your CAMBRIDGE FIELD ENGINEER to discuss how you can eliminate batch handling from your heat treating. Look under "BELTING, MECHANICAL" in your classified phone book. OR, write for your copy of Special Report, "6 Ways to Increase Heat Treating Production" and 130-PAGE REFERENCE MANUAL giving mesh specifications, design information, metallurgical data.

The Cambridge Wire Cloth Company

WIRE CLOTH | METAL CONVEYOR BELTS | SPECIAL METAL FABRICATIONS

Department A
Cambridge 6,
Maryland

OFFICES IN PRINCIPAL INDUSTRIAL CITIES

For more information, turn to Reader Service Card, Circle No. 426

Culver City, Calif. The film—Califilm—and the sheets—Kelon-F—are made of monochlorotrifluoroethylene, i.e., Kel-F and Fluorothene.

The "bondized" sheets and film can be cemented to steel, aluminum, wood, plastics, cardboard or rubber. They are said to be suitable for parts that encounter wear or corrosive conditions, such as tank liners and coverings, jigs and fixtures, pipe, ducts, valve facings and machine parts.

Califilm is available in thicknesses ranging from 0.005 to 0.015 in. and in widths up to 16 in. Kelon-F sheets, treated on one or both sides, are available in thicknesses ranging from 0.015 to 0.250 in.

Protective Coating Based on Neoprene

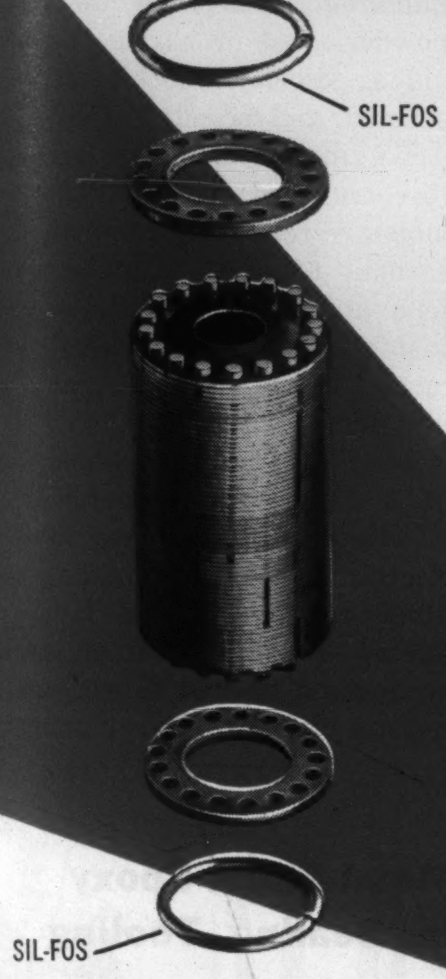
A neoprene base protective coating, developed by *Chemical Coatings & Engineering Co.*, Broomall, Pa., is reported to last a long time without losing its protective ability. Called Corrocote No. 362, it is said to have good adhesion to metal, concrete, wood and fabric.

According to the company, coatings can be exposed continuously at air temperatures up to 250 F and intermittently to 300 F. Films of 0.003-0.005 in. thickness per coat can be applied. Applications include pipe exteriors, tanks, power transmission shafts, air conditioning and ventilating equipment, electrical switch and terminal housings, wire, fans and impellers.

Cellulose Wadding for Packaging

A cellulose wadding, called Cel-Fibe, has been introduced by the *Cel-Fibe Div., Personal Products Corp.*, Milltown, N. J. Advantages

Only 4 minutes to braze 5 rotors with *SIL-FOS*



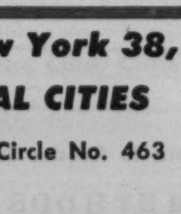
For joining non-ferrous metals, SIL-FOS is tops in speed and economy. What's more, joints made with this remarkable low-temperature silver brazing alloy are tops in strength, in electrical conductivity and in corrosion-resistance. That's why so many electrical manufacturers use SIL-FOS for making both current-carrying and structural assemblies.

FOR EXAMPLE

Air Marine Motors, Inc., Amityville, New York — a top producer of sub-fractional hp a.c. motors — use SIL-FOS to assemble rotors. Illustrations show how they do it ... with a setup that "automation-izes" the actual brazing.

Copper and brass end rings are induction brazed to copper pins extending through laminations. Parts are assembled on a 5-place fixture. Handy Flux is brushed on. A SIL-FOS ring is simply laid on top. Close-up shows fixture in brazing position.

Heating time for both ends, 5 rotors at a time, is just 4 minutes. At right is a finished rotor — a strong, permanent assembly.



GET THE AMAZING *SIL-FOS* STORY IN FULL

WRITE TODAY FOR BULLETIN 20

HANDY & HARMAN
FOUNDED 1867
QUALITY
SERVICE
ORIGINATORS OF EASY-FLO & SIL-FOS

HANDY & HARMAN

General Offices: 82 Fulton St., New York 38, N. Y.

DISTRIBUTORS IN PRINCIPAL CITIES

OFFICES and PLANTS
BRIDGEPORT, CONN.
PROVIDENCE, R. I.
CHICAGO, ILL.
CLEVELAND, OHIO
DETROIT, MICH.
LOS ANGELES, CALIF.
TORONTO, CANADA
MONTREAL, CANADA

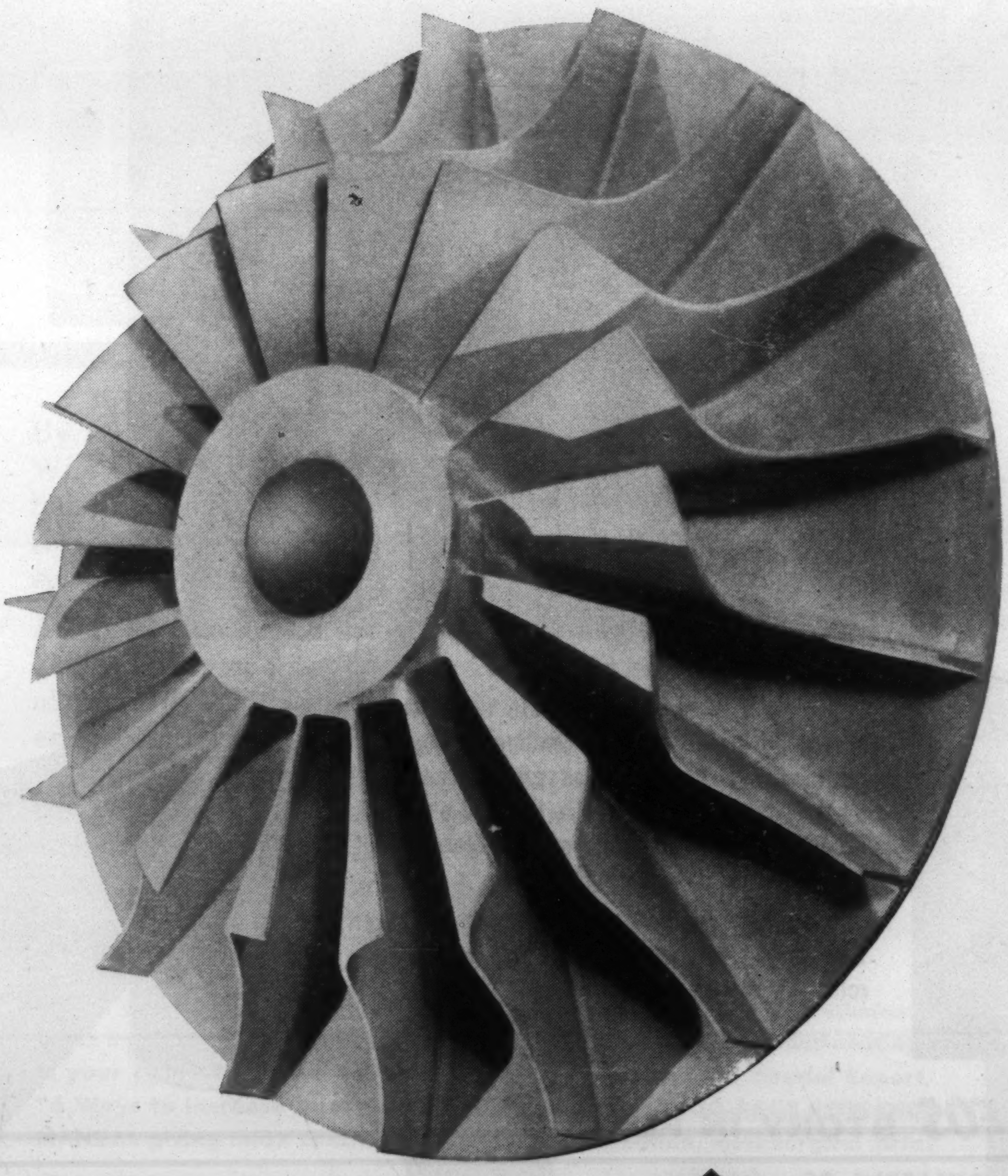
For more information, turn to Reader Service Card, Circle No. 463

Few casting requirements are more demanding than those imposed by manufacturers using high speed aluminum impellers. This example, an aluminum supercharger impeller, has the required smooth fluid flow surface, the metallurgical quality and uniformity to consistently pass rigid spin tests, and the accuracy to deliver designed performance and minimize balancing.

Morris Bean & Company is an acknowledged leader in the field of quality fluid flow castings. Send for booklet which includes pictures and specifications on outstanding fluid flow castings.

Morris Bean & Company
Yellow Springs 5, Ohio

a Morris Bean impeller



BEAN

For more information, turn to Reader Service Card, Circle No. 579

claimed over wood fiber and textile materials include use of fewer wrapping materials and ease of handling. Cel-Fibe does not powder, dust or shred. It can be glued, die-cut, sliced, stitched, seamed and scrolled. Used as a packaging material it is laminated to corrugated board. Available in moisture-repellent or moisture-absorbent form, it insulates, cushions and divides multiple items inside a container. There is no mess in wrapping and unwrapping.

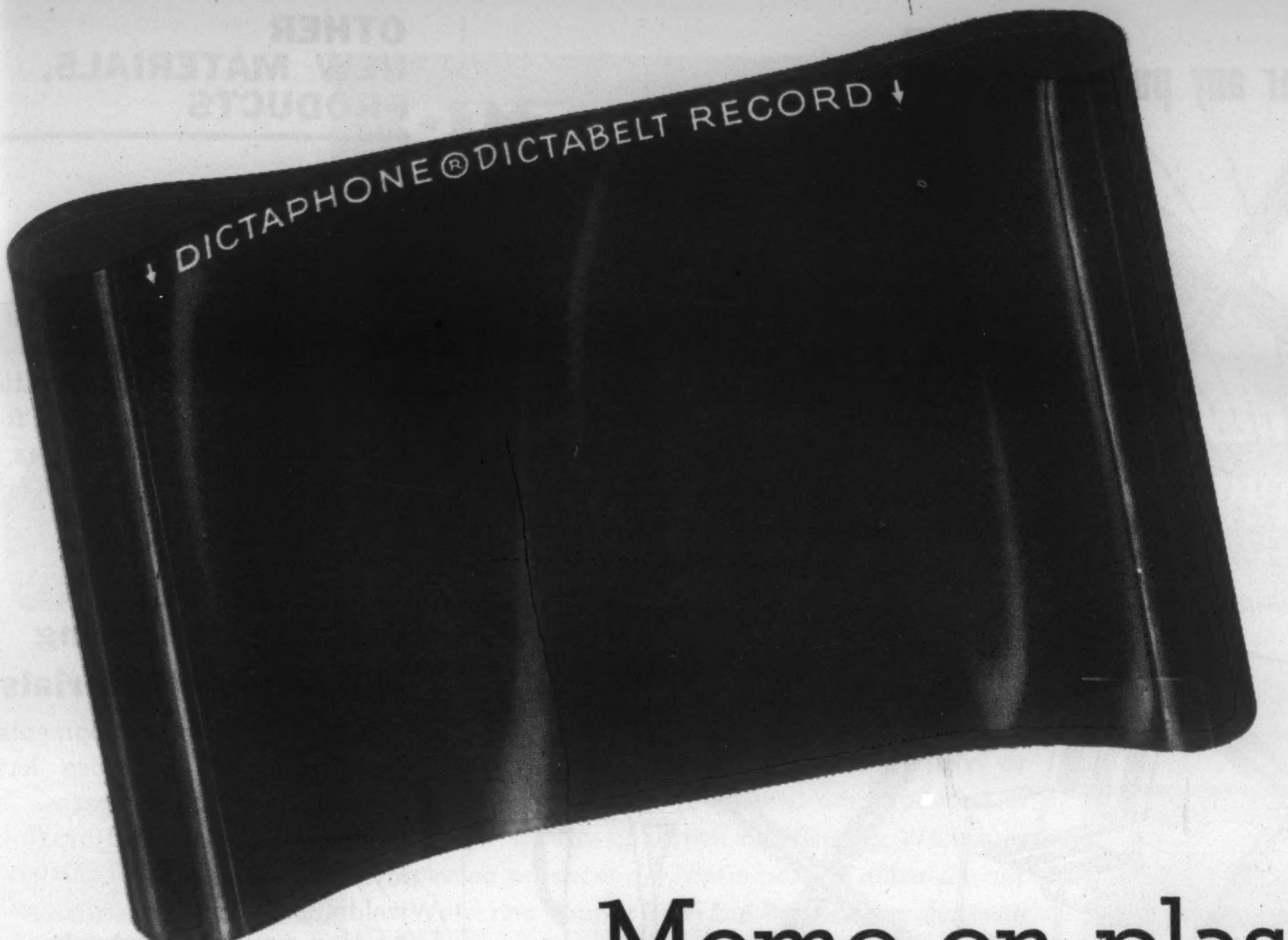
Cel-Fibe wadding, when made of a specially fusable fiber, can be electronically seamed in a dielectric welder. The wadding combined as filler betwen layers of one of several plastics or textiles produces a quilted fabric said to resist considerable wear and tear.

Metal-Filled Epoxy for Sealing, Tooling

A self-hardening plastic-metal compound is claimed to offer almost twice the volume per pound, compared to steel-filled epoxy compounds. Called Formex 77, it has been developed by *Travaco Laboratories,* 233 Condor St., East Boston 28, Mass. It combines epoxy and other resins with undisclosed metallic alloys and is claimed to exceed previous steel- and aluminum-filled epoxies in impact strength and ease of use.

Available in both liquid and nonsagging putty form, the compound has a controlled pot life of 3 to 90 min. When mixed with the catalyst supplied, it is said to harden in minutes, leaving a fine grain surface that sands and machines like soft gray iron. It takes a primer, lacquer or baked enamel and resists temperatures from —60 F to 350 F. It is waterproof and impervious to acids, oil, alkalies, solvents and other chemicals.

Formex 77 is said to bond to all metals, plastics, ceramics and



Memo on plastic

To all executives seeking a material for a new product or a way to improve an existing product:

As a case in point, consider the advantages Dictaphone Corporation finds in manufacturing its Dictabelt records of Tenite Butyrate. This versatile Eastman plastic provides a flexible, lightweight recording material that can be folded, mailed or filed, without damage. It's easily extruded as a seamless, thin-wall tube, and cut into bands—providing a smooth surface for accurate reproduction. Its clear, pure color is modern and attractive. And its low manufacturing cost permits users to record an average day's dictation for just four cents.

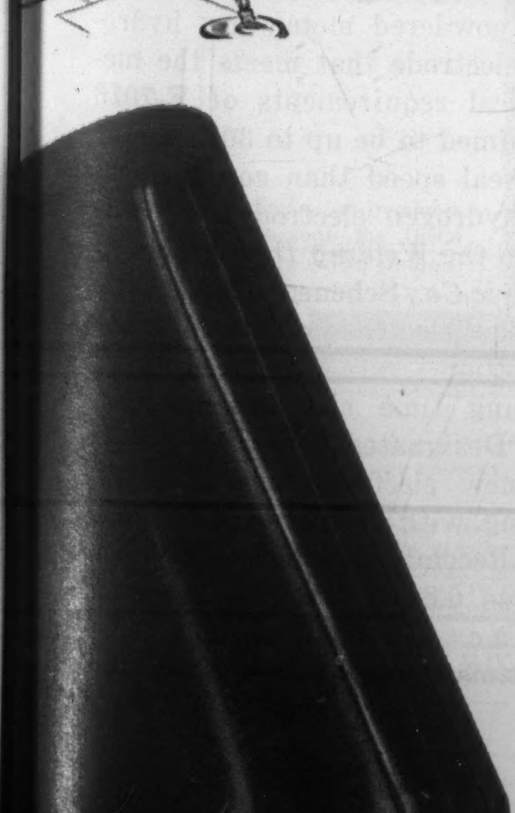
You'll meet Tenite Butyrate in many different forms. It is used for oil field pipe . . . for outdoor signs . . . for typewriter keys. Chances are you touch it daily, for auto steering wheels and the new color telephones are made of this versatile plastic.

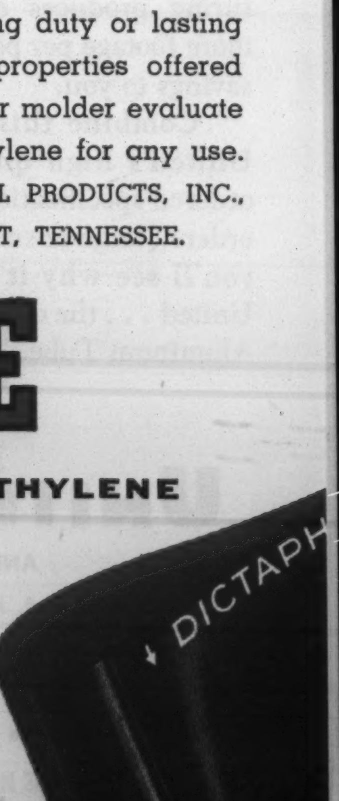
Whether you're seeking a material for demanding duty or lasting beauty, consider the hard-to-find combination of properties offered by Tenite plastics. We'll be glad to help you or your molder evaluate Tenite Acetate, Tenite Butyrate and Tenite Polyethylene for any use. For more information, write to EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

TENITE

ACETATE • BUTYRATE • POLYETHYLENE

plastics by Eastman





For more information, turn to Reader Service Card, Circle No. 370

For any purpose
Highest-quality aluminum tube
...at a lower cost per foot!
Permanently United

Now you can maintain highest quality standards at a lower cost wherever seamless aluminum tubing is used! Precision manufacturing produces closer tolerances that yield more footage per pound. This means important savings to you.

Combine this profitable economy with United's high quality, strict adherence to ordered specifications, ability to produce special orders (large or small) and fast delivery. Then you'll see why it's wise to specify and buy United . . . the quality name in Seamless Drawn Aluminum Tube.

UNITED WIRE
AND SUPPLY CORP.
PROVIDENCE 7, R. I. • OFFICES IN PRINCIPAL CITIES

LOOK TO UNITED FOR THE BEST IN ALUMINUM, COPPER AND BRASS TUBE AND WIRE

For more information, turn to Reader Service Card, Circle No. 468

concrete. It can be molded to any shape for repairing leaks and for sealing and filling in holes and cracks. Among other applications, it can be used for precision forming dies, models, molds, jigs and high speed centrifugal disks.

Welding, Soldering and Joining Materials

Recent joining developments include welding electrodes having higher deposition rates, new paste-type solders and brazing alloys and prefabricated corners for weldments.

1. Iron powder electrode

Rocket 14, an iron powder type electrode, has been designed by *Hobart Brothers Co.*, Troy, Ohio, for a.c. and d.c. operation. The iron powder in the coating is said to permit welding at higher currents to increase deposition rates over those of conventional E-6014 type electrodes.

The arc is reported to be soft and stable in all positions and there is no tendency to stick on a.c. or d.c. Weld contour is easily controlled by arc length. The weld bead is smooth, the slag easily removed and there is little splatter.

The electrode is available in sizes ranging from 1/8 to 5/16-in.

2. Low hydrogen electrode

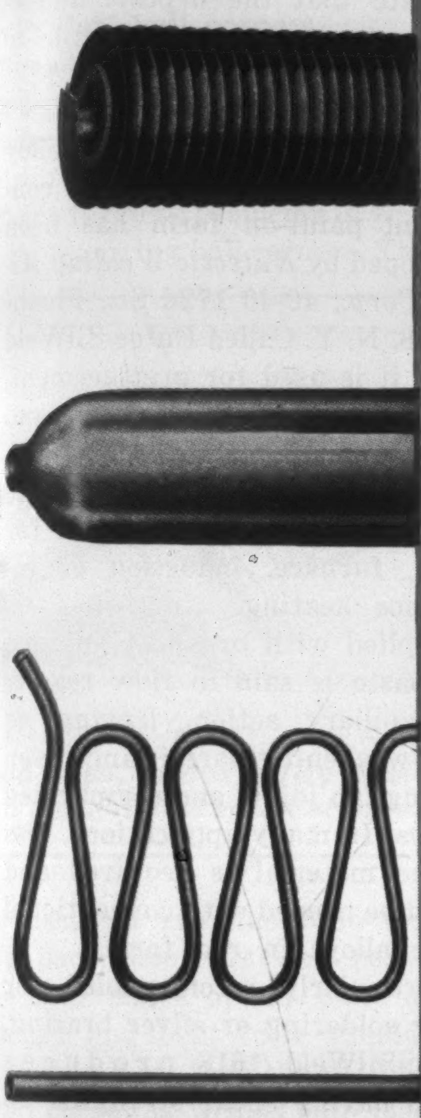
A powdered metal, low hydrogen electrode that meets the mechanical requirements of E-7016 is claimed to be up to 30% faster in lineal speed than conventional low hydrogen electrodes. According to the *Welding Dept., General Electric Co.*, Schenectady 5, N. Y., the new electrode offers a higher deposition rate, reduced slag cleaning time and less splatter loss. Designated Strikeasy LH-2 the new electrode has a heavy coating with powdered metal added. Recommended for use with reverse d.c., it can also be used with a.c.

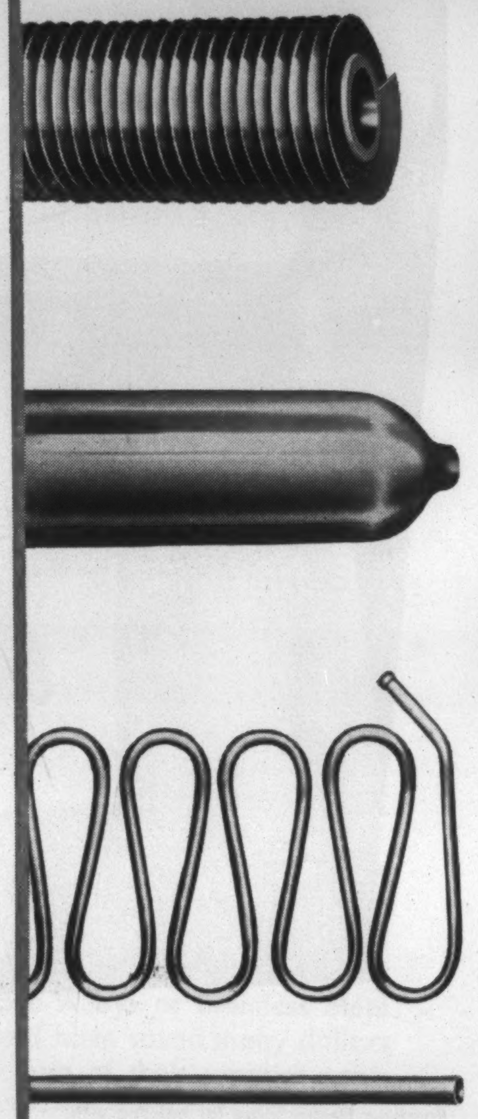
Ultimate tensile strength of the

OUTSTANDING WOLVERINE DEVELOPMENTS

IN COPPER

IN ALUMINUM





INCREASED HEAT TRANSFER

Wolverine Trufin**—with integral fins—has much greater heat transfer surface than plain tube—transfers more BTU's per foot of tube. Trufin is available in a wide range of sizes and alloys in both copper and aluminum.

INCREASED SAVINGS THROUGH SPINNING

One-piece, tubular-shaped parts, with fully or partially closed end treatments, are produced in a single speedy operation by spinning. Wolverine spinning produces dry, clean parts in either copper (Wolverine Copper Spun End Process*) or aluminum (Wolverine Aluminum Spun End Process †).

PRECISION IN FABRICATING TUBULAR PARTS

Wolverine's rigid quality control, its complete fabrication facilities, and the Tubemanship of its skilled employees insure fabricated tubular parts that will meet the toughest specifications. Wolverine is equipped to fin, spin, bend, coil, flare, expand, bead—*you name it*—in either copper or aluminum.

COMPLETE ALLOY AND SIZE RANGE

Wolverine manufactures tubing in a wide range of alloys and sizes in both copper and aluminum. You receive the tube or tubular-shaped part that is exactly right for your job—every time!

JOINING DISSIMILAR METALS

Sometimes, manufacturers wish to use both aluminum and copper tube in the same system. Wolverine furnishes handy copper-to-aluminum connectors in both 3/8" and 5/16" tube diameters.

Wolverine Tube, 1439 Central Ave., Detroit 9, Mich.

Wolverine Trufin is available in Canada through the Unifin Tube Company, London, Ontario.

* *REG. U.S. PAT. OFF.
*A PATENTED PROCESS RE. 22465
†PROCESS PATENT APPLIED FOR

Creative Tubemanship—IN ACTION!

DIVISIONS OF
CALUMET & HECLA, INC.

CALUMET DIVISION
WOLVERINE TUBE DIVISION
CANADA VULCANIZER
& EQUIPMENT CO., LTD.
FOREST INDUSTRIES DIVISION
GOODMAN LUMBER CO.

WOLVERINE TUBE
Division of Calumet & Hecla, Inc.
Manufacturers of Quality-Controlled Tubing and Extruded Aluminum Shapes

PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES.

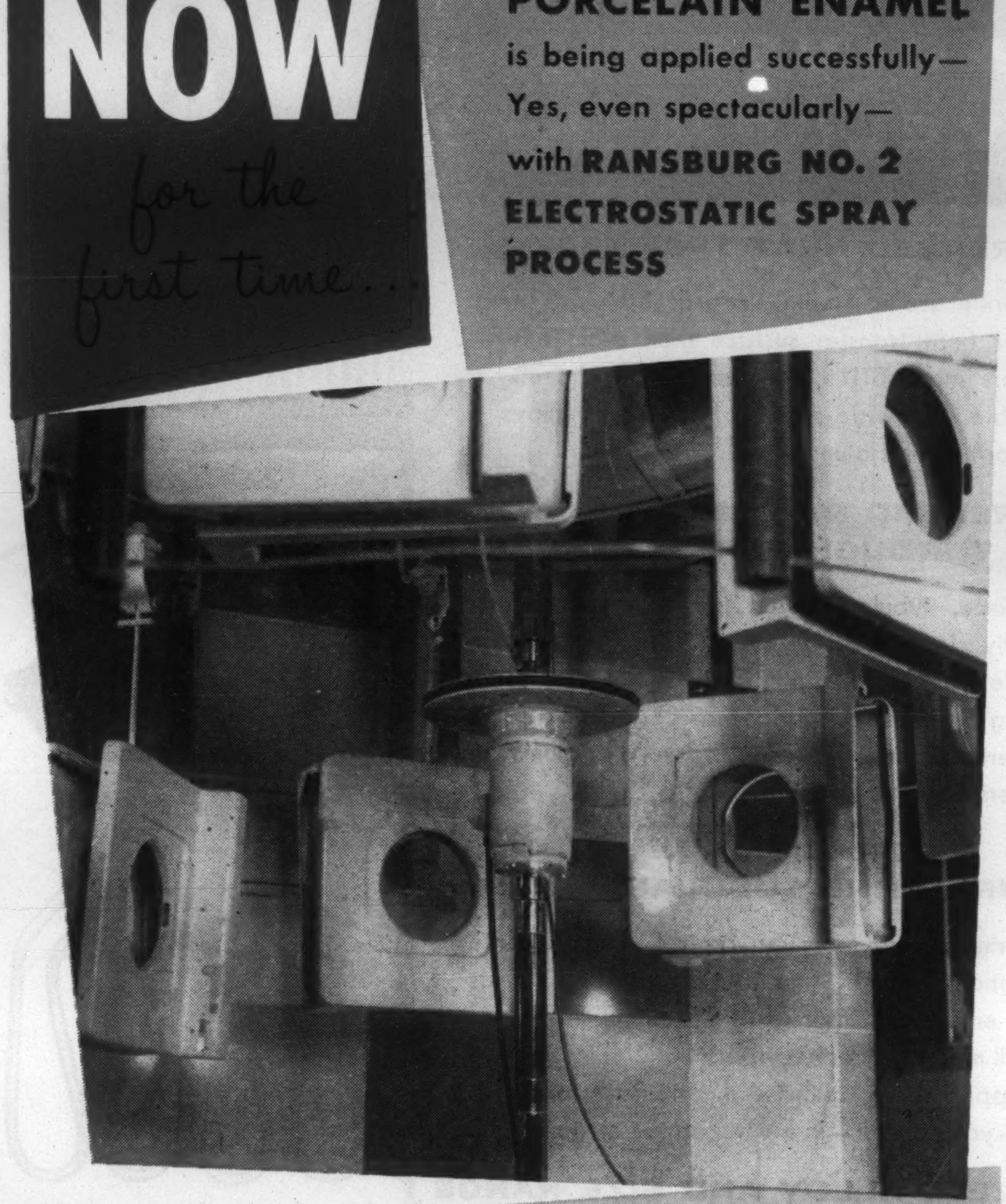
EXPORT DEPT., 13 E. 40TH ST., NEW YORK 16, N.Y.

5256

For more information, turn to Reader Service Card, Circle No. 566

NOW
for the first time...

PORCELAIN ENAMEL
is being applied successfully—
Yes, even spectacularly—
with RANSBURG NO. 2
ELECTROSTATIC SPRAY
PROCESS



General Electric—an extensive user of Ransburg Electro-Spray for painting with synthetic enamels—is the first to use Ransburg No. 2 Process in the application of porcelain enamel.

GE—less than a year in electrostatic production—now is processing almost a million square feet of cover coat each month in the General Electric Home Laundry finishing department at Appliance Park.

DRYER TOPS AND WASHER COVERS ARE BEING COATED ELECTROSTATICALLY WITH THESE SPECTACULAR RESULTS

Quality of appearance and chip resistance are greatly improved with all colors: white, yellow, pink, turquoise, blue and brown.

About 97% of the atomized enamel is deposited on the washer and dryer parts.

Because of improved uniformity in coating thickness, weight of applied enamel was substantially reduced.

Because of lower application weight, the few rejected parts can be re-processed more times before being scrapped. This reduces the ultimate scrap rate by at least 95% of that previously expected.

Efficiency, measured by the amount of good ware, averages above 90%.

Want your products tested?

Ransburg has fully equipped laboratory facilities including reciprocating disks, helical conveyors, stationary disks, and the latest advancements in equipment for applying porcelain enamel with the No. 2 Electrostatic Spray Process. Manufacturers are invited to send sample products to our Indianapolis laboratories for tests and demonstrations to prove for you the advantages and benefits of electrostatic spray application of porcelain enamels.

Ransburg ELECTRO-COATING CORP.
Indianapolis 7, Indiana

RANSBURG

For more information, turn to Reader Service Card, Circle No. 362

OTHER NEW MATERIALS, PRODUCTS

weld deposit (as welded) is 80,000-83,000 psi, yield strength is 70,000-73,000 psi, and elongation in 2 in. is 34%. Impact tests indicate that the deposit undergoes a transition from ductile to brittle fracture below —40 F.

3. Paste brazing alloy

A high silver content alloy blended with special flux in convenient paint-on form has been developed by *Eutectic Welding Alloys Corp.*, 40-40 172d St., Flushing 58, N. Y. Called Eutec-SilWeld 1618, it is used for preplacement, tinning, filling, overlaying and joining on all metals except aluminum, magnesium and the white metals. It is said to be ideal for torch, furnace, induction or resistance heating.

Applied with brush or spatula, the paste is said to flow readily by capillary action, leaving no joint-weakening bare islands even on long lap joints and complicated shapes. In many applications, less of the material is required and would be needed with conventional silver alloys in rod form.

Particularly recommended for silver soldering or silver brazing, Eutec-SilWeld 1618 produces joints having shear strengths up to 125,000 psi. Its unique composition is claimed to permit bonding at 25 to 150 F below the temperatures required by conventional high silver bearing alloys. It meets specifications for AWS-ASTM-BAG-7.

4. Paste solder

A new paste solder, when heated, cleans, tins and solders in one operation, requiring only wiping with a damp cloth to complete the job. Developed by *Hercules Chemical Co.*, 416 Broadway, New York 13, and called Swif Solder 50-50, it is a tin-lead solder combined with an active flux. It can be applied with a brush or any standard applicator and heated with a soldering iron, a torch or in a production line oven.

Used in plumbing for several years, Swif Solder can be ap-

(Continued on p 197)

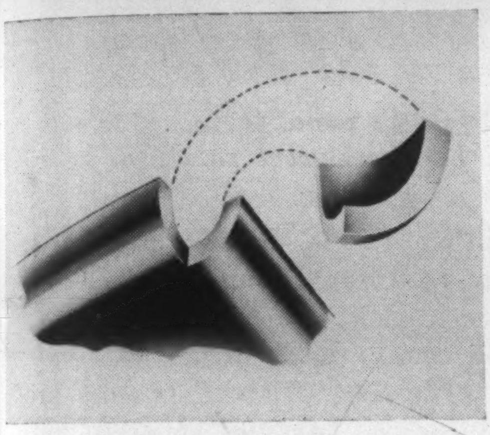
For more information, Circle No. 537 ›

OTHER NEW MATERIALS, PRODUCTS

plied in fine lines or small spots wherever needed, even in difficult corner locations and sleeved joints. Joints are reported just as strong as ordinary soft solder joints.

5. 'Prefab' ball corners

Rounded prefabricated steel corners, designed by *Conner Steel Products*, 24690 Telegraph Rd., Detroit 19, are claimed to solve difficult forming problems in weldments requiring ball corners. They are used on machine base tops, drip pans, housings and panels. The four edges of the plate are notched and bent to a standard Conner radius; then the prefabricated corner is welded into place. Called Conner Spherical Corners, they are available in 1020 steel in thicknesses ranging from 1/8 to 1/2 in. and inside radii ranging from 1 to 2½ in.



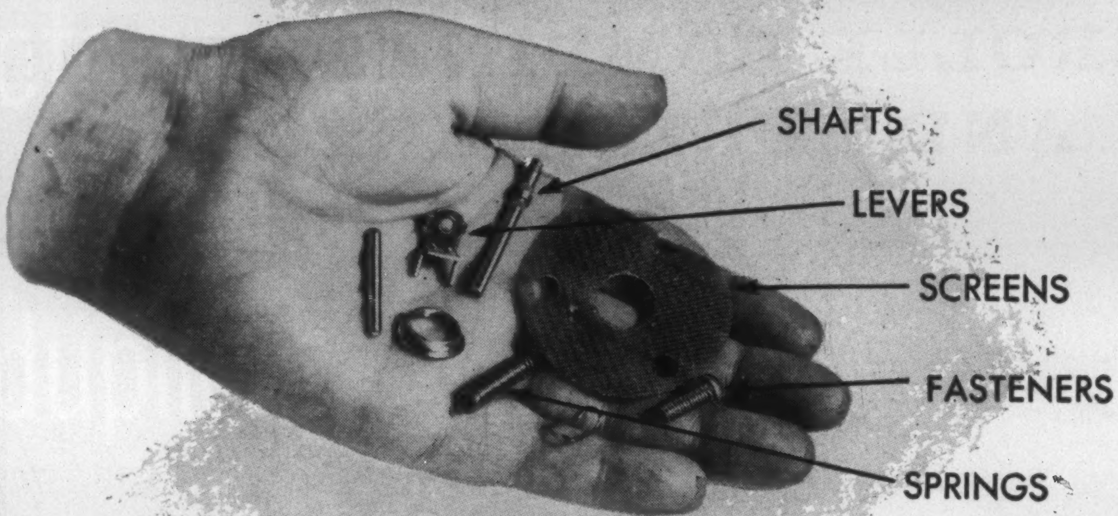
***Fluid lines,** greater safety possible with prefabricated spherical corners.*

Glass-Polyester Panel Resists Erosion

A glass fiber-reinforced polyester panel is claimed to last six times longer than ordinary translucent panels. Developed by *Corrulux Div., L-O-F Glass Fibers Co.*, P. O. Box 20026, Houston 25, Tex., the material is called Granitized Corrulux.

For test purposes, controlled sandblasting was used to simulate the effects of rain, sand and sleet erosion over a long period. The new panel withstood up to six times more sandblasting than

ARE *small* PARTS CAUSING YOUR PRODUCT FAILURES?

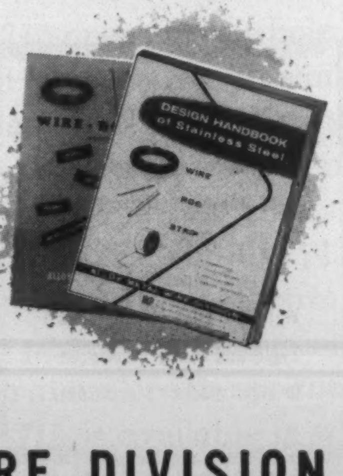


It Will Pay You To Use ALLOYS

How many times can you trace your product failure to the corrosion, wear or breakage of some small part? A screw . . . a shaft . . . small spring . . . a gear or other seemingly insignificant part? In most cases the failure can be blamed on the material from which the part was made. The use of Nickel Alloys or Stainless Steel Wire, Rod or Strip for these parts could have saved many dollars in service and replacement costs because of their superior engineering properties.

How much more will alloy materials cost? Actually, on small parts, fabrication, finishing and other manufacturing costs will more than likely far overshadow material cost. You will find that the extra cost of using alloys will be insignificant compared with the benefits in longer service life, lower maintenance costs and fewer customer complaints.

For informative technical data on our alloys . . . and for some good ideas . . .



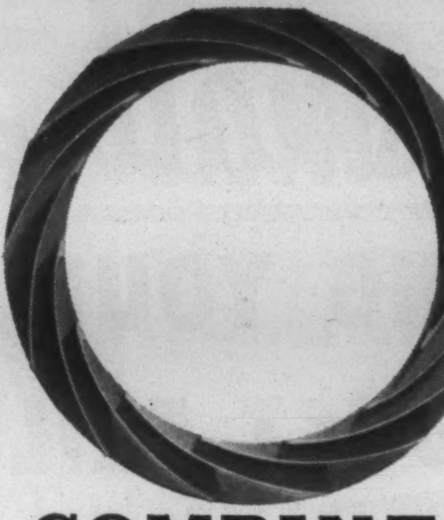
SEND TODAY FOR OUR NICKEL ALLOY AND STAINLESS STEEL DESIGN HANDBOOKS.

ALLOY

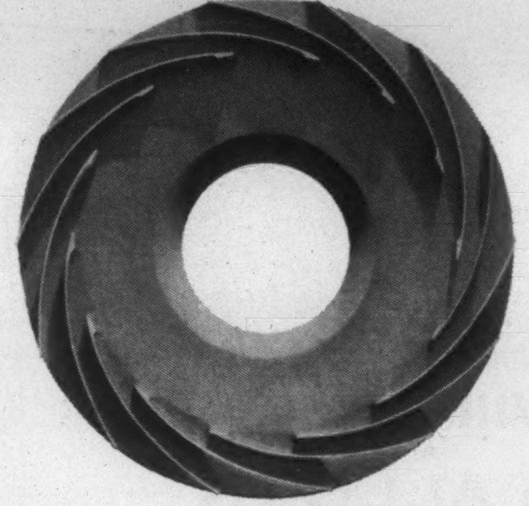
ALLOY METAL WIRE DIVISION

HKP H. K. PORTER COMPANY, INC.
Prospect Park, Pennsylvania

For more information, turn to Reader Service Card, Circle No. 481



ROLLE COMBINES SHELL AND PERMANENT MOLD



FOR AIRCRAFT DIFFUSER

The problem was finding the one *best* method for casting this aluminum aircraft diffuser. A method that would meet *all* requirements . . . providing the utmost in economy as well as fine surface finish and high dimensional accuracy in the critical vane areas.

Rolle foundry engineers carefully studied the part . . . then recommended semi-permanent mold casting, with a shell core for the vane area.

Using this method, vane thickness is held to within .008″ among vanes. Surface finish measures from 60 to 100 micro-inches as compared to 125 to 150 standard with permanent mold alone. Wall thickness is held to within .015″. And this better casting actually costs less than it would by any other casting method.

PERTINENT DATA
Permanent mold and shell cast aluminum aircraft part
Alloy 355
Temper T51
Weight 7 pounds, 6 ounces
Zyglo and X-ray inspection to rigid aircraft standards.

Your casting problems, whether they involve sand, permanent mold, shell mold, or investment casting, of aluminum or magnesium—can always be solved quickly and economically if you bring them to Rolle.

FREE 57-Page ENGINEERING MANUAL on designing aluminum and magnesium castings available on letterhead request. Write now for your personal copy.

for complete foundry service **ROLLE**
MANUFACTURING COMPANY
303 Cannon Avenue, Lansdale, Pa. Lansdale 5162

For more information, turn to Reader Service Card, Circle No. 488

OTHER NEW MATERIALS, PRODUCTS

***Plastics panel** is claimed to outlast other translucent panels six to one.*

other panels. Panel material immersed for 10 min in 95% sulfuric acid is said to have been virtually unaffected.

The "granitizing" process produces a surface covered with minute facets of tough polyester. These facets protect the glass fiber from erosion and assure a consistently higher level of light transmission. There are no sharp ridges on the surface to impede cleaning or to serve as dirt catchers.

Epoxy Resins Suitable for Surface Coatings

A series of epoxy resins for corrosion resistance coatings have been developed by *Bakelite Co., Div. of Union Carbide & Carbon Co.,* 260 Madison Ave., New York 16. These resins can be formulated into air drying or baking finishes for steel, aluminum, zinc, tin plate and wood. They can be applied by brushing, spraying, dipping, roller coating or flow coating.

Suggested applications include scuff resistant floor varnishes, indoor enamels, appliance coating primers and tank linings. Collapsible tube finishes, electrical insulation varnishes and masonry paints are other possible uses.

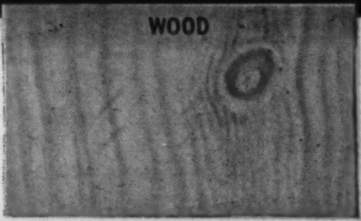
Currently three of these resins

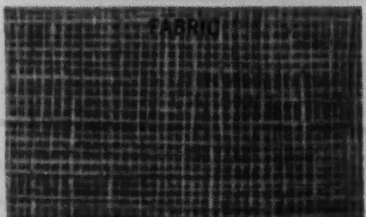
For more information, Circle No. 527

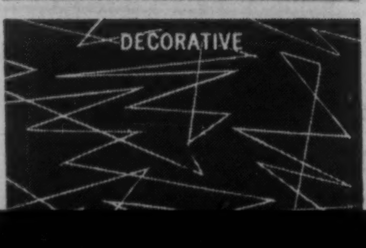
anything
that can be
photographed...
can be
duplicated on

GEN®

a completely new idea in decorative plastic sheeting







here can you use **GEN 715?**

*pplications for Gen 715 are literally without limit. Here are ist a few suggested uses—*appliance interiors and housings furniture • wall and ceiling tile • advertising specialties • otion picture and stage settings • three-dimensional wood" paneling • displays and advertising signs

ight now you probably can think of many other ways of sing Gen 715. More ideas will come to mind. For the present —if you would like samples of Gen 715 plus additional nformation, write to

PLASTICS DIVISION
GENERAL AMERICAN
TRADE MARK

LASTICS DIVISION
ENERAL AMERICAN TRANSPORTATION CORPORATION
35 South La Salle Street • Chicago 90, Illinois

Available in extruded sheets...
or vacuum formed to
your specifications

Gen 715 opens up a whole new world of creative possibilities for designers. By means of an exclusive process, General American Plastics Division is now able to supply plastic sheeting and formed parts that bear perfect reproductions of any material, pattern or design. Gen 715 is available in widths up to 40 inches and any desired lengths . . . in thicknesses from .040 inches to .187 inches.

custom made
thermoplastic
EXTRUSIONS

made to your specifications in any on 10 thermoplastics* ranging from rigid to elasomeric. Rods, tubes, strips, shapes; curved, cored or fabricated; in an unlimited range of colors and finishes.

Anchor's facilities include an ultra-modern research, development and design department staffed by engineers and technicians whose sole responsibility is to aid you in your design and production problems.

Write TODAY for your free brochure on Extruded Plastics

ANCHOR PLASTICS COMPANY, INC.
36-36 36th Street
Long Island City 6, N. Y.

RODS • TUBES • SHAPES
MOULDINGS • FABRICATED PARTS

VISIT OUR BOOTH #327, NATIONAL PLASTICS EXPOSITION, NEW YORK COLISEUM, JUNE 11-15

For more information, Circle No. 435

OTHER NEW MATERIALS, PRODUCTS

are available: EKRA-2053, EKRD-2003 and EKRA-2002. All are condensation products of the reaction between epichlorohydrin and bis-phenol A. In general all of them have good compatibility with phenolic resins, urea-formaldehyde resins and simple rosin esters, but they are not generally compatible with alkyds and cellulose derivatives.

Oleoresinous coatings

EKRA-2053 is a solid, friable, pale-amber resin, designed primarily for esterification. It is cooked with vegetable oil acids to provide air drying and baking coatings said to have excellent adhesion, chemical resistance and impact resistance. Ketones, ether alcohols and esters are generally good solvents for the resin, whereas alcohols and aromatic hydrocarbons are poor ones. However, mixtures of aromatic hydrocarbons with ketones or certain alcohols are good solvents.

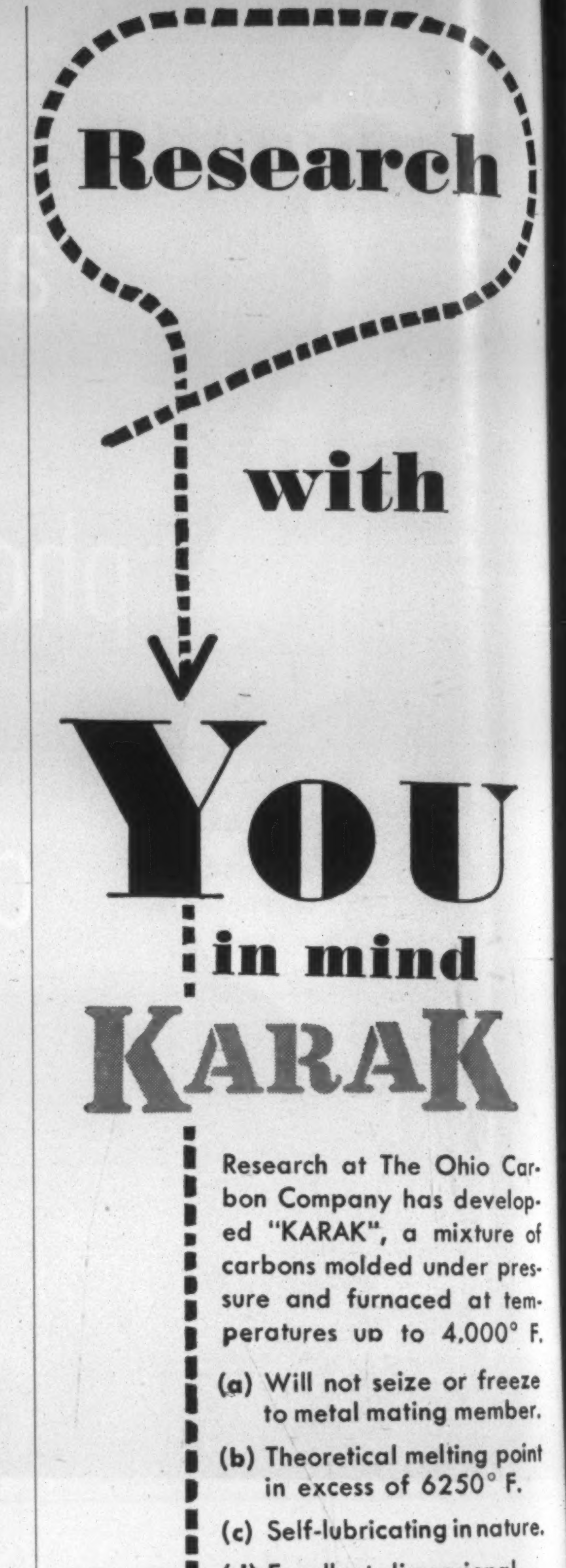
EKRD-2003 is similar in every way to EKRA-2053, except that in short-oil varnishes it yields vehicles of somewhat higher viscosity for the same solids and cooking time.

Synthetic coatings

EKRA-2002 is also a solid, friable, crystal-clear, pale-amber resin for air drying and baking coatings. Lower melting and lower in molecular weight than EKRA-2053 and EKRD-2003, it is intended primarily to be reacted with hardeners or curing agents, such as amines, polyamides and urea-formaldehyde resins. This resin can also be esterified with vegetable oil acids and will undergo all other reactions common to epoxy resins.

EKRA-2002 is generally applied from solution. A mixture of 25% methyl isobutyl ketone and 75% toluene is reported to be satisfactory for most uses.

In addition to the solid resin form, EKRA-2002 is also available



Research at The Ohio Carbon Company has developed "KARAK", a mixture of carbons molded under pressure and furnaced at temperatures up to 4,000° F.

(a) Will not seize or freeze to metal mating member.
(b) Theoretical melting point in excess of 6250° F.
(c) Self-lubricating in nature.
(d) Excellent dimensional stability.
(e) Thermal conductivity less than that of silver or copper.
(f) Specific resistance range is from .0004 to .0020 ohms per inch cube.

Check these properties and characteristics. In today's design there is a growing need for "KARAK".

design with KARAK in mind

THE OHIO CARBON COMPANY
12508 BEREA RD., CLEVELAND 11, OHIO

For more information, Circle No. 391

How many plastics does your product need?

Are you sure it's getting all the performance and sales advantages that the right plastics can offer? How up-to-date is your knowledge of plastics? How many of the newer plastics are you familiar with?

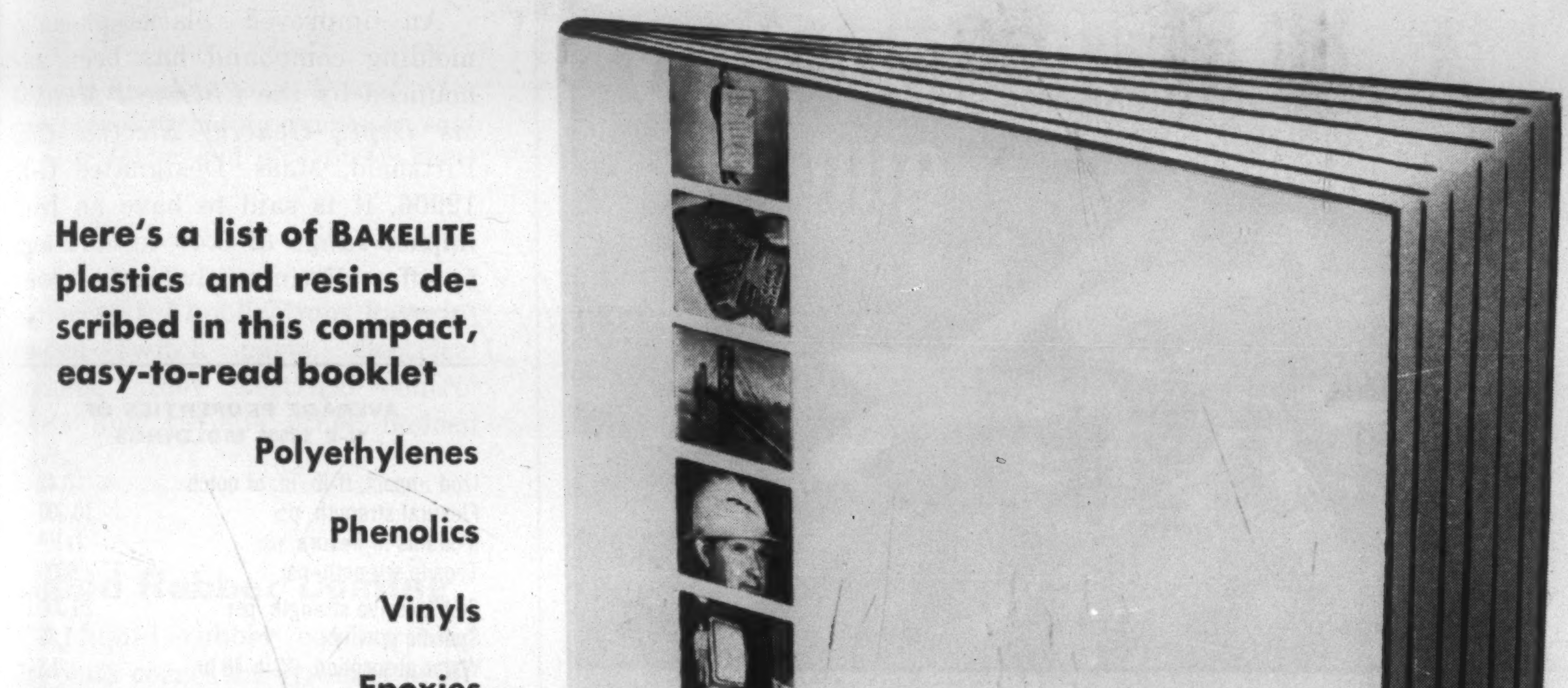
Best way to learn whether plastics can improve your product—and which plastics will do it best—is to get expert advice from Bakelite Company.

Bakelite Company offers the greatest variety, has the largest resources, for plastics keyed to your needs. These materials cover a range of forms and fabricating techniques—molding, extrusion, laminating, coating, bonding, calendering, reinforcing. Their properties include electrical, mechanical, decorative, structural, and protective advantages.

You'll find the new 1956 BAKELITE Condensed Reference File a helpful guide. Other publications, giving technical data on the material in which you're most interested, are also available. And experienced Bakelite Company technical representatives are at your service. Just write Dept. QD-108.

Here's a list of BAKELITE plastics and resins described in this compact, easy-to-read booklet

- Polyethylenes
- Phenolics
- Vinyls
- Epoxies
- Styrenes
- Impact Styrenes
- Polyesters
- Acrylonitrile-Styrenes



See BAKELITE'S exhibit, booths #807, 813, 817, 825, National Plastics Exposition, June 11-15, 1956, New York Coliseum, New York.

BAKELITE COMPANY, *A Division of Union Carbide and Carbon Corporation* UCC 30 East 42nd Street, New York 17, N. Y.
In Canada: Bakelite Company, Division of Union Carbide Canada Limited, Belleville, Ontario
The term BAKELITE and the Trefoil Symbol are registered trade-marks of UCC

For more information, turn to Reader Service Card, Circle No. 510

New "gun" sprays hi-temperature ceramic coatings at high speed with high deposit efficiency

the new
METCO
ThermoSpray
gun

The unique characteristics of ceramic coatings as heat insulators and their resistance to abrasion has led many designers to investigate possible applications for these materials. However, their actual use has been severely limited because of the high cost of application with previously available spraying equipment.

Now with the new METCO THERMOSPRAY GUN these materials can be applied many times faster than was previously possible and deposit efficiency is in excess of 95%, making the use of these coatings economically feasible.

These high spraying speeds and deposit efficiencies are made possible by entirely new design concepts which result in the excellent thermal efficiency of the METCO Type P THERMOSPRAY GUN as well as the specially developed and carefully controlled characteristics of the THERMOSPRAY Ceramic Powders.

for additional information see facing page

The following trade names are the property of Metallizing Engineering Co., Inc. METCO, THERMOSPRAY. *Reg. U. S. Pat. Off.*

METCO ®

Metallizing Engineering Co., Inc.
1175 Prospect Ave., Westbury, L. I., New York • cable: METCO
In Great Britain: Telephone: EDGEWOOD 4-1300
METALLIZING EQUIPMENT COMPANY, LTD.—Chobham near Woking, England

For more information, turn to Reader Service Card, Circle No. 572

as a 75% solution in toluene. Designated EKSA-2002, this resin solution offers a wide variety of formulating possibilities; a 50% solids solution may contain one-third toluene and two-thirds of any other solvent desired.

Improved Phenolic Molding Powder

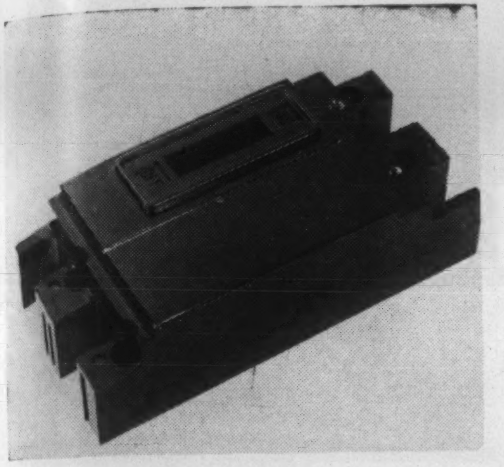
An improved black phenolic molding compound has been announced by the *Chemical Materials Dept., General Electric Co.*, Pittsfield, Mass. Designated G-E 12906, it is said to have an Izod impact range of 0.40 to 0.44 and to offer distinct advantages over previously available improved impact compounds.

Despite its higher impact properties, G-E 12906 is reported to be suitable for automatic molding processes, due to its granulation and fast curing properties. Other advantages include uniform pill weight and excellent preformability in tableting machines. Filled with wood-flour and cotton-flock, the compound is said to produce molded parts with finish superior to conventional improved impact

AVERAGE PROPERTIES OF G-E 12906 MOLDINGS

Izod impact, ft-lb/in. of notch	0.42
Flexural strength, psi	10,000
Modulus in flexure, psi	1×10^6
Tensile strength, psi	6000
Compressive strength, psi	25,000
Specific gravity	1.36
Water absorption, % in 48 hr	0.8
Shrinkage, mils/in.	6.5
Hardness, Rockwell M	96
Heat distortion point, F	300
Dielectric strength:	
60 cps, 77 F, short time, v/mil	325
60 cps, 212 F, short time, v/mil	90
Power factor:	
60 cycles—dry	0.25
1000 kc—dry	0.053
Dielectric constant:	
60 cycles—dry	10.0
1000 kc—dry	6.0
Volume resistivity, ohm cm units	2×10^{11}
Insulation resistance, megohms	7×10^4

OTHER NEW MATERIALS, PRODUCTS



***Circuit-breaker** cover is made of a new phenolic molding compound, said to pour faster and give faster cure.*

materials, with or without preheat.

Successful applications have included switch parts, electrical sockets, other electrical control parts and various other molded parts.

Liquid Rubber Coating

A liquid rubber coating that prevents corrosion by acids or alkalies in tanks or other types of equipment has been developed by *Rubba, Inc.*, 1015 E. 173rd St., New York 60. Called Rubbakote, the coating seals small leaks by forming a continuous rubber film. Applied by brush or spray, the coating is self-vulcanizing, requires no mixing and adheres to metal and wood. It is available in black, red and aluminum. A good coating is claimed to withstand five to ten years of use.

PVC Pipe Has High Bursting Strength

A rigid pipe extruded of high strength polyvinyl chloride is claimed to offer an unusual combination of chemical resistance, high bursting strength and toughness. Made by *American Hard Rubber Co.*, 93 Worth St., New York 13, it is called Riviclor. The unplasticized PVC material has an Izod impact strength as high as 2.5 ft-lb. The glossy in-

Hi-temperature sprayed ceramic coatings now economically practical

METCO
ThermoSpray Gun

Spraying thermo-couple tube with zirconia to provide superior protection against high temperatures.

Open new possibilities for the design engineer

Development of the new METCO THERMOSPRAY GUN for spraying high-melting-point ceramic materials at low cost opens up a variety of new practical applications for the design engineer, particularly in the protection of equipment against high temperatures and abrasion.

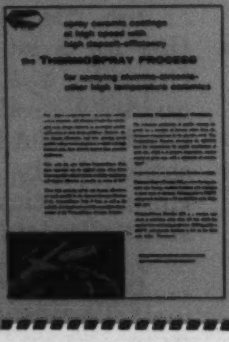
Immediately available for use in such production applications are two THERMOSPRAY Ceramic Powders. No. 101 is a free-flowing alumina with excellent hardness and resistance to many types of abrasion. Melting point is 3700°F. and particle hardness is 9.0 on the Moh scale. Color of this material as sprayed is a light grey. Second THERMOSPRAY Powder is No. 201—a zirconia, somewhat softer than No. 101 but with superior heat-insulating properties. Melting point 4600°F. and particle hardness 8.0 on the Moh scale. Color—tan-brown.

Both of these materials may be sprayed with the new THERMOSPRAY equipment many times faster (up to 15 sq. ft. per hr.—.010" thick) than has been possible for equipment previously available and deposit efficiencies are in excess of 95%. These factors produce extremely low coating costs and make coatings of this type economically feasible.

Preliminary engineering data contained in Bulletin 127 is now available and may be obtained by filling out the coupon below or writing on your company's letterhead. There is no obligation involved.

Hard-facing alloys, *of the self-fluxing, nickel-boron-silicon type, in powder form, can also be applied with the METCO Type P* THERMOSPRAY GUN. *Write for Bulletin 126.*

FREE BULLETINS



METCO

Metallizing Engineering Co., Inc.
Westbury, L. I., N. Y. • Great Britain: Chobham near Woking

1175 Prospect Avenue, Westbury, Long Island, New York
Please send me ☐ free bulletin 127 (Ceramic coatings), ☐ free bulletin 126 (Hard facing).

NAME

TITLE

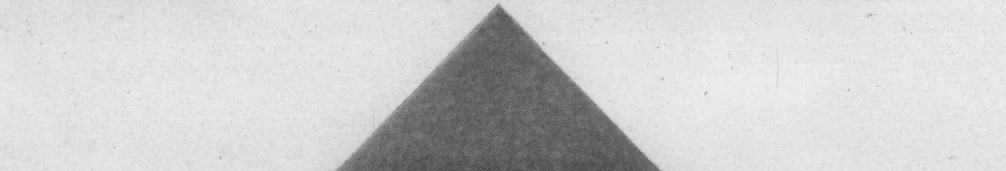
COMPANY

ADDRESS

CITY ZONE STATE

For more information, turn to Reader Service Card, Circle No. 573

LEBANON'S NEW CERAMICAST® PROCESS NOW IN QUANTITY PRODUCTION OF TWO AIRCRAFT STEEL CASTINGS



...the BENDIX 149543. This backing plate for the Bendix disc-type aviation brake was previously fabricated in light alloy materials. When increased heat and stresses made it mandatory to change to steel, Lebanon was given the assignment. Backing plates were redesigned as cast steel parts and are now in quantity production at Lebanon.

...the CHANCE VOUGHT 15-510664-1. This support fitting for a jet engine removal track in the Chance Vought Crusader was originally produced as a machined part. When quantity production made this cost impractical, Lebanon's CERAMICAST Process was able to meet all requirements satisfactorily at a considerable cost saving. The desirable characteristics of the original machined part have been substantially retained.

...OUR SERVICE TO YOU. The aircraft industry is finding increasingly wider use for the CERAMICAST Process. We invite you to send us your blueprints or to visit our Plant in Lebanon. Our engineers will show you how CERAMICAST is adaptable to your project design.

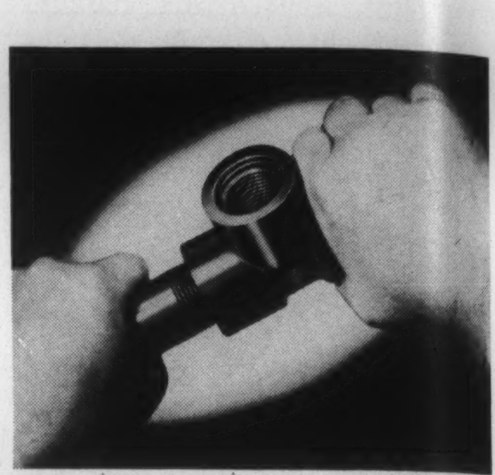
WRITE FOR CERAMICAST LITERATURE: Bendix and Chance Vought Case Histories; CERAMICAST Technical Bulletins.

CIRCLE L

LEBANON STEEL FOUNDRY
113 LEHMAN STREET LEBANON, PENNSYLVANIA
CARBON, LOW ALLOY AND STAINLESS STEEL CASTINGS

For more information, turn to Reader Service Card, Circle No. 575

OTHER NEW MATERIALS, PRODUCTS



***PVC pipe** remains tough and brittle at relatively low temperatures.*

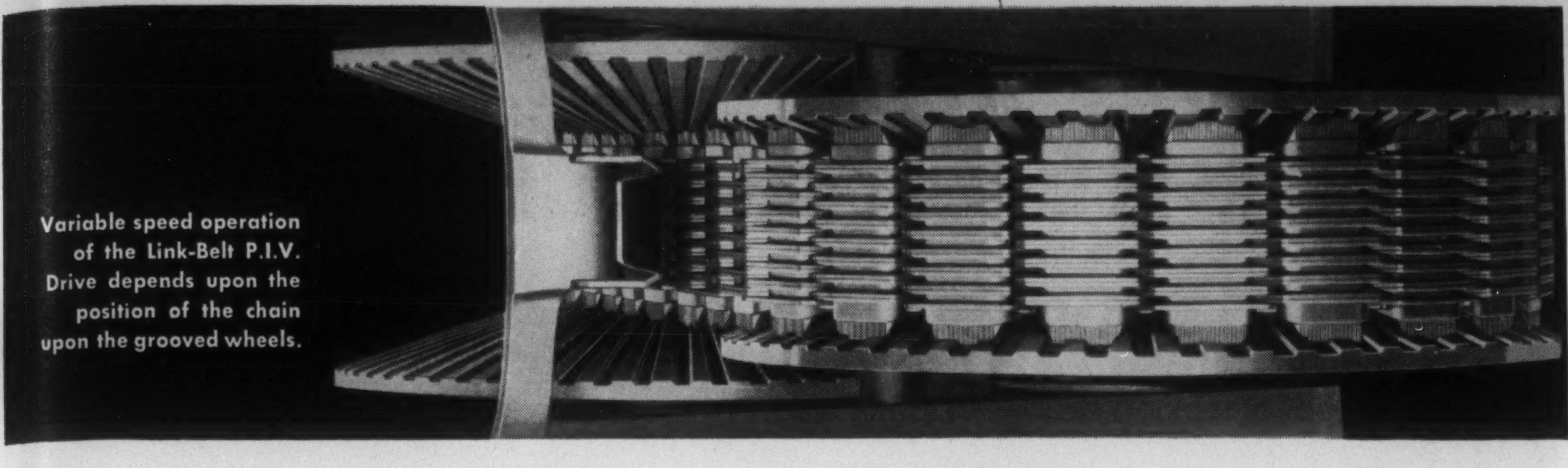
side surface of the pipe is reported to reduce head loss and permit greater flow than the equivalent size of steel pipe.

Pipe and fittings are available in ½ to 2-in. standard or extra heavy wall construction. At 70 F, working pressure of the ½-in. extra heavy pipe is 490 psi and that of the 2-in. extra heavy pipe is 255 psi. Though recommended maximum pressure decreases as temperature goes up, the pipe will retain rigidity at temperatures up to 160 F under most conditions.

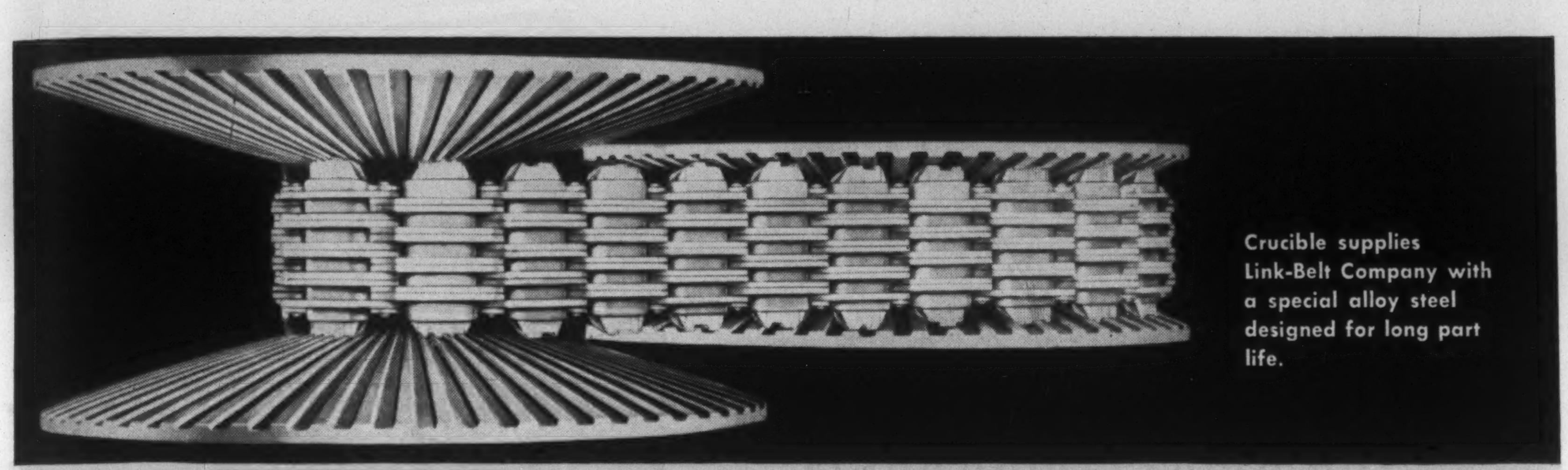
High Boiling Lacquer Solvent

Ethyl amyl ketone, a high boiling lacquer solvent, is now available in unlimited tankcar quantities from *Shell Chemical Corp.*, 50 W. 50th St., New York 20. It is reported to be a better solvent for nitrocellulose than any other high boiling lacquer solvent commonly used. EAK is said to provide excellent blush resistance and diluent tolerance with high solvency for coating materials. It may be used for both nitrocellulose and vinyl coatings.

The solvent is colorless and stable with a mild, pleasant odor. Its applications include automobile lacquers, furniture lacquers, industrial maintenance vinyl coatings and silk screen printing lacquers.



Variable speed operation of the Link-Belt P.I.V. Drive depends upon the position of the chain upon the grooved wheels.

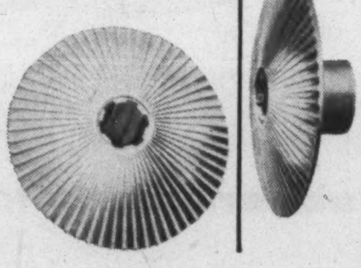


Crucible supplies Link-Belt Company with a special alloy steel designed for long part life.

these

SPECIAL ALLOY STEEL PARTS

keep Link-Belt's P.I.V. Drive on the job



Keeping production operations going at the right speed is the job of this variable speed drive unit produced by Link-Belt Company. Its operation is based on an exclusive drive chain with self-forming metal teeth, which engage with radial grooves in two pairs of cone-shaped wheels.

To make these precision wheels requires a steel that can be readily machined, will not distort, and which has high-strength. That's why Crucible furnishes Link-Belt with a special Nitriding BM alloy steel *designed* for this application. After machining the wheels are Nitrided to obtain a minimum surface hardness of 1000 Vickers Diamond Brinnel — about the hardest surface that can be obtained commercially.

When your application requires a tough, machinable, nondeforming alloy steel — call Crucible. One of our many special alloy grades may be the right one for you — or we can develop one to meet your most exacting demands. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

CRUCIBLE **first name in special purpose steels**

Crucible Steel Company of America

For more information, turn to Reader Service Card, Circle No. 546

"BREAKAGE IS NIL

since we switched to...

G.E.'s shock-resistant

Rubber-Phenolic

molding compounds"

DAY
NIGHT
TYPE
179-M
INSTRUCTIONS
Burglar Alarm System

That's what the American District Telegraph Company, New York City, reports! As Chief Engineer M. H. A. Lindsay says, "The covers for our burglar alarm control units must be rugged! These units are usually located on store walls where things get knocked against them. A lot of our covers used to be broken even though made of 'impact-grade' plastics. But now, since we switched to a General Electric shock-resistant *rubber*-phenolic, our field reports read: 'Breakage is nil'."

Where can YOU use G-E rubber-phenolics?

Shock-resistant G-E rubber-phenolics offer you an ideal plastic for applications where high-impact strength and resiliency are "musts." They produce parts which resist breakage in assembly and service, accommodate large metal inserts without cracking, and permit lightweight designs without heavy reinforcement.

Design File
Rubber-Phenolics
General Electric

For a complete case history brochure on G-E rubber-phenolics, just write to General Electric Company, Section 6C3B1, Chemical Materials Department, Pittsfield, Mass.

Progress Is Our Most Important Product

GENERAL ELECTRIC

For more information, turn to Reader Service Card, Circle No. 385

CONTENTS NOTED

Highlights of current papers, plus a list of recent books and reports.

This month

- *Metal Powder Assn. papers*
- *Russian sulfidizing treatments*
- *Designing with transparent plastics*
- *Glass for electronics*

Sulfidizing Metals for Wear Resistance

Russian journals have reported considerable work recently on use of sulfidizing treatments to improve wear resistance of machine parts and cutting tools. Difficulties in its use evidently stem from lack of information as to the nature of the process, and inadequate control. Developments in one factory were reported in the February issue of *Vestnik Mashinostroyeniya* by I. M. Engalychev and P. I. Zemskov.

The authors compared a porous sulfide treatment with various other types of coatings, such as tin plating, chromium plating, oxide coating and phosphating. They treated cast iron piston rings. For this "soft" coating, aqueous sulfidizing baths, analogous to oxidizing or phosphating were used. Although the porous, sulfidized layer was rapidly worn away during testing, its use seemed to guarantee good run-in properties, either dry or with insufficient lubrication.

Porous coatings did not penetrate into the surface of the metal. In order to obtain penetration, water-free salt baths were used. Laboratory results shown in the accompanying table indicate the potential of the process. In service, sulfidized rings showed more wear than chromium plated rings, slightly more than tin plated rings, less than phosphated rings and several times less than uncoated rings.

Various salt baths were tried for high speed steel cutting tools. Two of the baths increased life of twist drills by 1.5 to 2 times. All the data gathered indicate that sulfidizing increases wear resistance and improves run-in properties of bearing surfaces.

EFFECT OF SULFIDIZING CAST IRON PISTON RINGS

Lubrication	Surface Treatment	Moment of Friction, kg-cm: 30 kg Test Load	Moment of Friction, kg-cm: 120 kg Test Load
None	None	30-35	....
None	Sulfidized	4-5	....
Limited	None	8-10	26-30
Limited	Sulfidized	3-3.5	12-14

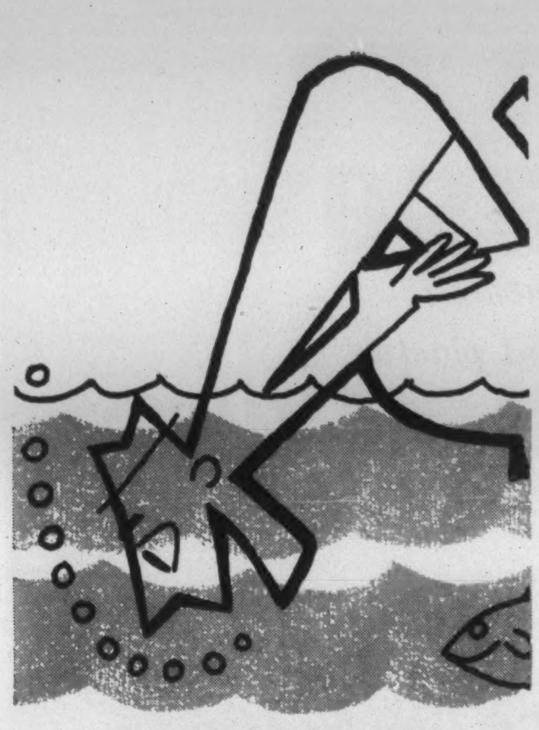
Powder Metallurgists Discuss Progress

Eleven papers and a panel discussion featured the 12th annual meeting of the Metal Powder Assn. held in Cleveland during April. Although major attention was devoted to progress in the application of metal powder parts, several new materials and process developments were covered also.

Of particular interest was a paper by J. P. Lyle, Jr., of Alcoa, on aluminum powder metallurgy products. This paper (see M&M, Apr '56, p 106) discussed the properties and applications of two grades of material, produced from aluminum oxide-coated aluminum powder, that are now in semi-commercial production. Properties of age hardenable brass powder alloys and ceramic-metal friction materials were also discussed; these materials are still in the laboratory stage.

Progress in the application of metal powder parts in a number of industries was discussed in a series of six papers. Subjects covered were: applications in nuclear engineering, business machines, and the electrical and electronic industries; the use of heavy metal; and replacement of castings by metal powder parts.

Brief summaries of some of these papers follow. The complete



want to know how to get your head above water?

use the NEW completely integrated facilities of the Kawneer Aluminum EXTRUSION PLANT

- 2200-ton press!
- cast own billets!
- superior high finish!
- prompt delivery!

SAVE INSPECTION, HIGH INVENTORY, DELAY AND FINISHING COSTS

Write For New Folder
P. O. Box No. 468
St. Charles, Ill.

50TH ANNIVERSARY
Kawneer
General Offices
NILES, MICHIGAN
MILL PRODUCTS DIVISION
1906-1956

For more information, Circle No. 516

CONTENTS NOTED

papers will be published by the Association in the near future.

Age hardenable brass

Brass powder parts of conventional composition have established a firm position in the powder metallurgy field. These parts are suitable for a wide range of applications, but the development of stronger materials will lead to broadening the field of application of brass parts.

E. A. Anderson and E. H. Rennhack, of New Jersey Zinc, reported that, although use of nickel phosphide for age hardening wrought copper base alloys is not new, adaptation to the metal powder process requires a number of changes. It is not possible to prealloy the phosphorus with brass or copper powder for the production of parts. Instead, the phosphorus must be added as a compound, copper phosphide for example, and diffusion during sintering must be relied on to produce the desired composition. Therefore, important deviations in composition are necessary to obtain optimum properties; in particular, substantially higher ratios of phosphorus to nickel are required.

With suitable adjustments of the phosphorus content, alloys containing up to 10% nickel can be made. However, the most practical alloy of this type contains about 1.5% nickel. The improvement obtainable by nickel phosphide additions is indicated by a comparison of the properties of a leaded 80-20 brass with those of a nickel-phosphide modification of the same alloy. The tensile strength of the modified alloy ranges from 43,000 to 48,000 psi compared with 30,000 psi for the standard alloy, Brinell hardness increased from 43 to 67, elongation from 20 to 29%.

Similar improvement in properties is obtained by substituting iron for part of the nickel. The major disadvantage of the new alloys is color. Since color is frequently one of the deciding factors in the selection of brass, the gray-yellow color of these new alloys may place some limits on their applications.

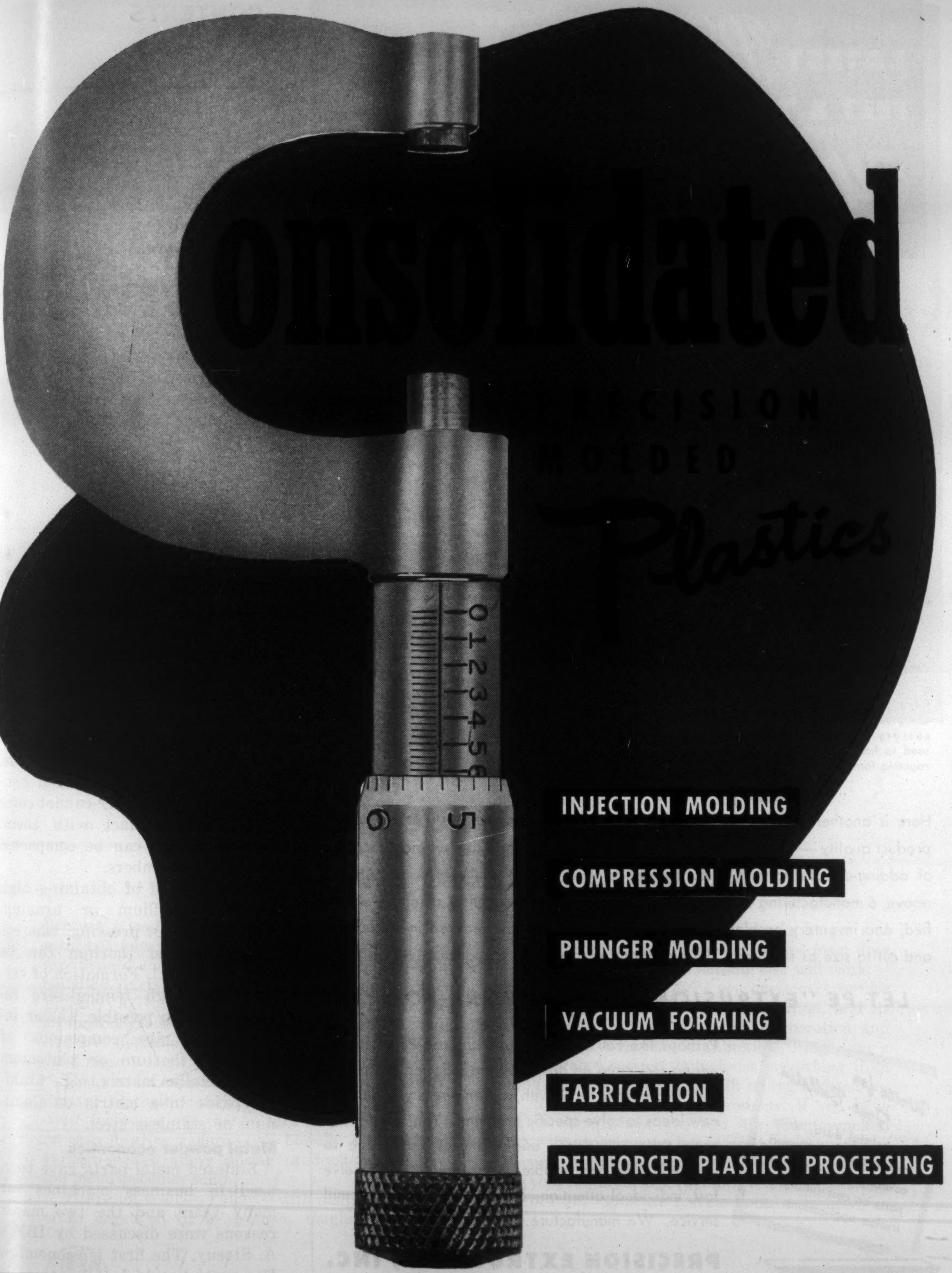
A valuable attribute of nickel phosphide hardened alloys is the fact that precipitation sufficient to give the desired hardness occurs while the parts are cooling at the exit end of the sintering furnace, thereby eliminating the necessity for subsequent heat treatment of the parts.

Ceramic-metal materials

Increased weight and landing speeds of aircraft, higher speeds of passenger automobiles and greater operating capacity of heavy industrial equipment place a heavy burden on friction materials serving in either brake or clutch applications. The high energies involved in these applications produce higher temperatures than have been encountered previously. Consequently, conventional frictional materials are being damaged or destroyed, and lining materials are needed that will function at higher temperatures. Because of their refractory nature, ceramic metal combinations have been investigated.

Ceramic-metal linings are not new, but the ceramic constituent was a minor portion of the earlier mixtures. L. D. Hower, Jr., and R. E. Steck, of Raybestos-Manhattan, described new types developed for clutch applications that contain appreciable quantities of ceramic materials. One, termed ceramic-modified metal, has a continuous metal phase; the other, termed metal-modified ceramic, has a continuous ceramic phase with metal as the minor phase. The metal-modified ceramic can operate at higher temperature than the ceramic-modified metal.

Experimental work has indicated that clutch facings in button form made from these new materials and having a friction area of only 25 to 40% of the area normally employed are producing a higher torque output


onsolidated
ECISION
OLDED
Plastics
0 1 2 3 4 5 6
0
5

INJECTION MOLDING

COMPRESSION MOLDING

PLUNGER MOLDING

VACUUM FORMING

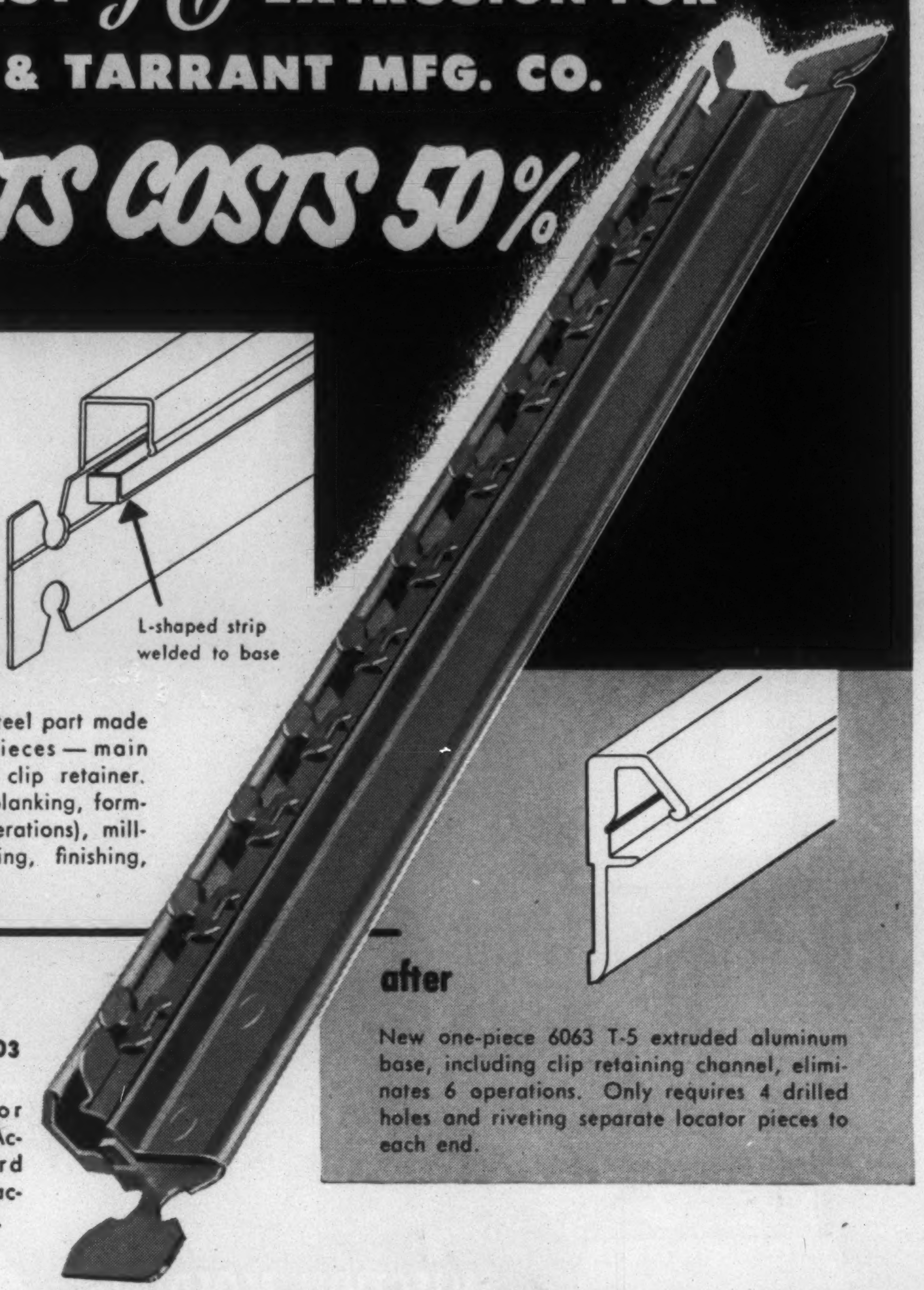
FABRICATION

REINFORCED PLASTICS PROCESSING

CONSOLIDATED MOLDED PRODUCTS CORPORATION

SCRANTON 2, PA.

For more information, turn to Reader Service Card, Circle No. 475



LATEST PE EXTRUSION FOR FELT & TARRANT MFG. CO.

CUTS COSTS 50%

Original steel part made of two pieces — main base and clip retainer. Required blanking, forming (3 operations), milling, welding, finishing, assembly.

New one-piece 6063 T-5 extruded aluminum base, including clip retaining channel, eliminates 6 operations. Only requires 4 drilled holes and riveting separate locator pieces to each end.

CASE STUDY 103

Clip strip for Comptometer Accessory Board used to hold accounting forms.

Here is another example of how PE Extrusioneering helps cut costs and improves product quality — this time for Felt & Tarrant Mfg. Co., world famous manufacturers of adding-calculating machines. By designing the aluminum extrusion illustrated above, 6 manufacturing operations were eliminated, (see sketches), assembly simplified, and inventory problems reduced. Extrusions are now ordered in 10' lengths and cut to size as required. These changes effected a 50% reduction in part costs.

LET PE "EXTRUSIONEERING" WORK FOR YOU

Write for Free Bulletin

For helpful data, write for free copies of PE news covering case study reports on cost cutting extrusion applications.

Perhaps like Felt & Tarrant you can use PE extrusioneering service to an advantage in reducing costs. Ask a PE Engineer to work with you and help you develop new ideas to solve specific problems. You can depend upon their experience and technical knowledge to save you time and trouble. Your inquiry will receive fast, individual attention. PE is a non-competitive mill service. We manufacture extrusions only.

PRECISION EXTRUSIONS, INC.
727E GREEN AVENUE BENSENVILLE, ILLINOIS
PHONE: BENSENVILLE 98 • CHICAGO TUxedo 9-1701

Chicagoland's Oldest, Most Experienced Aluminum Extruder

For more information, turn to Reader Service Card, Circle No. 428

CONTENTS NOTED

than normal facings, and that wear life has been increased two to four times. Field tests are giving similar indications.

Nuclear engineering uses

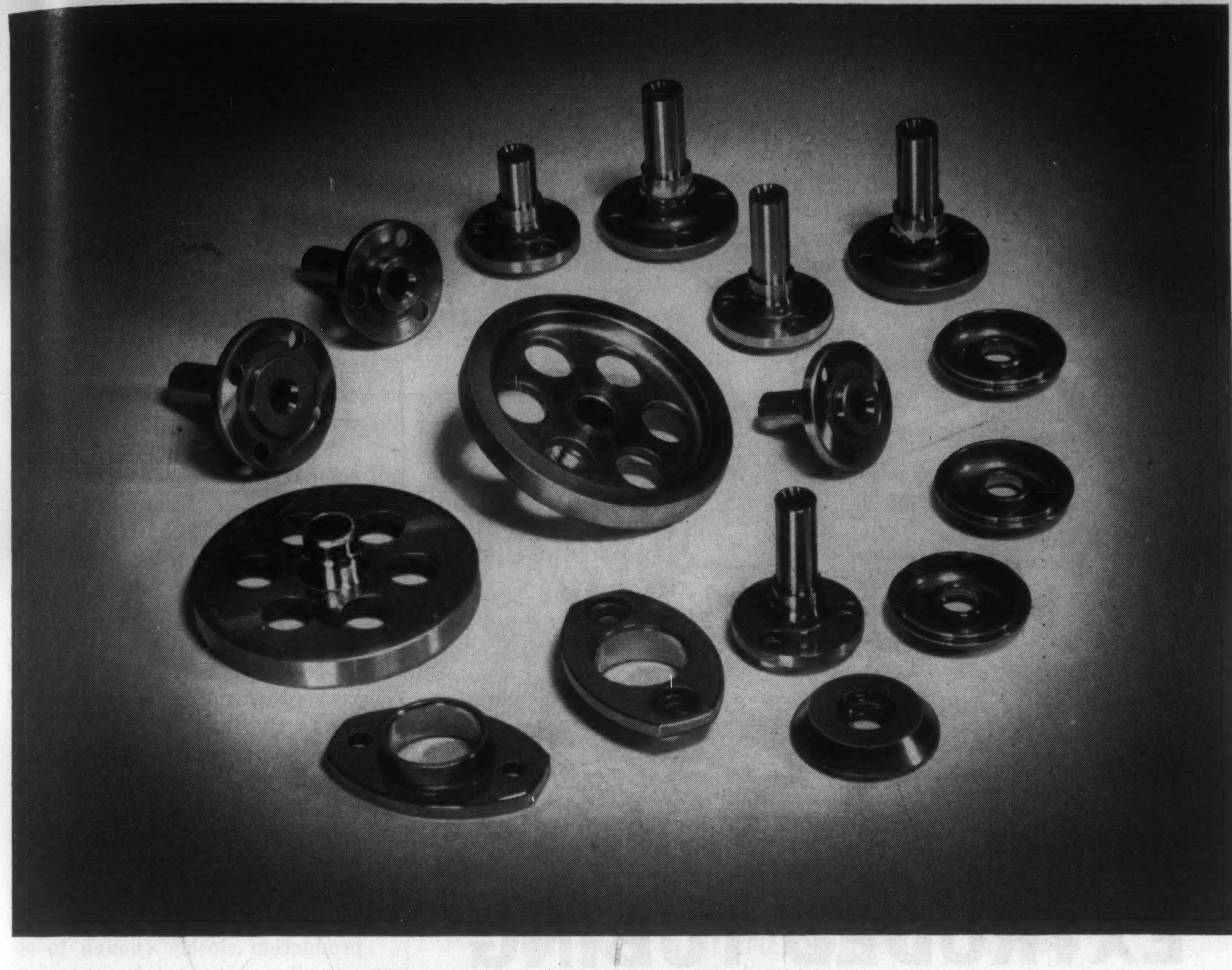
Many of the metallurgical problems in nuclear engineering are new because they involve effects not investigated previously and materials which were laboratory curiosities only a few years ago. Among these materials are uranium and thorium for fuel, beryllium for moderating purposes, and zirconium as a fuel component and construction material.

The properties and applications of these metals in powder form were discussed by H. H. Hausner, of Penn-Texas Corp. All four require extreme care in handling in powder form. Although solid beryllium is not dangerous, beryllium powder is extremely toxic. Zirconium powder is not toxic but is highly pyrophoric. Uranium and thorium powders are pyrophoric and highly toxic. Thus, these metals require special handling and the worker cannot come into direct contact with them. However, they can be compacted in special chambers.

Best method of obtaining high density beryllium or uranium compacts is hot pressing, whereas zirconium and thorium can be cold compacted. Formation of cermets for high temperature reactors is also possible. Under investigation are compounds of uranium, thorium or plutonium in a metallic matrix, e.g., uranium oxide in a matrix of aluminum or stainless steel.

Metal powder economics

Sintered metal parts have been used in business machines for many years and the two major reasons were discussed by IBM's A. Stosuy. The first is economics. For parts to which the process is applicable, the cost of producing precision shapes compares favorably with the cost of any other method of fabrication with the exception of simple stampings



bearing manufacturer gains over 300% higher yield with Vacuum Metals FERROVAC

Because a leading manufacturer of precision instrument bearings worked to such exacting standards, he experienced an exceptionally high rate of rejection of finished parts. Then they tried Vacuum Metals FERROVAC®. . . of the same basic analysis as the air-melted grade used previously. The results were decisive. Rejections were reduced to less than 1% – a yield improvement of better than three times.

That's to be expected from vacuum-melted alloys, because of their remarkable uniformity. Gases that cause inclusions and that in turn lead to rejection – or early bearing failure – are literally sucked from vacuum-melted alloys during production . . . before the metal becomes solid.

The result is a *clean* alloy – with many of its properties improved. It is stronger, tougher, far more resistant to wear and fatigue. It works longer and harder than conventionally-melted alloy – even does the super-tough jobs where *nothing else* will work.

Only Vacuum Metals gives you one-source service – Vacuum Metals' own large organization, and its affiliation with National Research Corporation and Crucible Steel Company of America, brings you a fully integrated service. It includes everything from melting and casting, through mill rolling and nationwide distribution of finished products. If you have an application where you can use vacuum-melted metals – in experimental lots or production quantities – Vacuum Metals can serve you. Write us now, outlining your requirements. *Vacuum Metals Corporation, P. O. Box 977, Syracuse 1, New York.*

VMC

VACUUM METALS CORPORATION

Jointly owned by Crucible Steel Company of America and National Research Corporation

For more information, turn to Reader Service Card, Circle No. 376

and screw machine parts. The second is machine improvement through the use of unique properties of sintered metal. Friction clutches, self-lubricating bearings, carbide wear-resisting parts, and contact points fall within this category. Various specific parts were discussed in the paper.

Mr. Stosuy pointed out that his company purchased most metal powder parts from outside suppliers but ran a captive plant also for the following reasons:

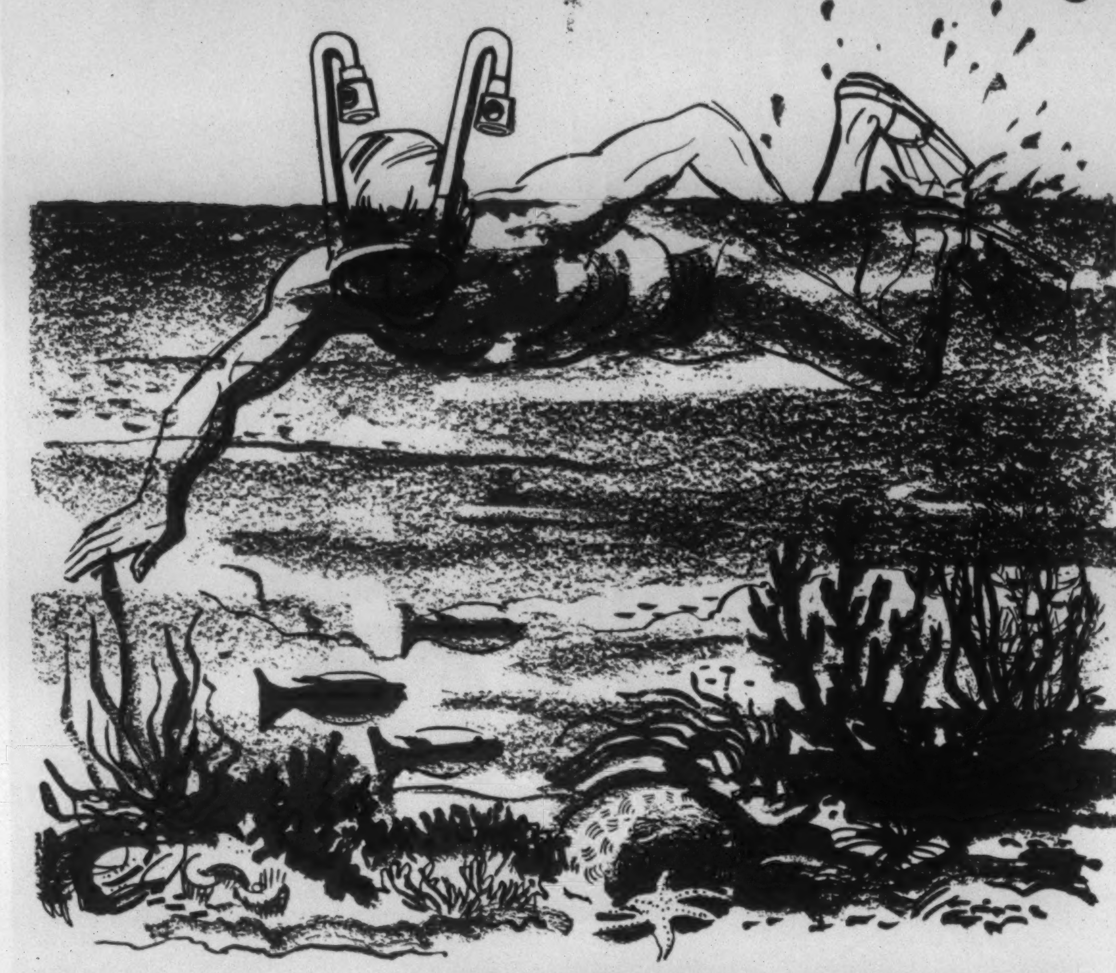
1. Commercial fabricators are not interested in producing short runs. A captive plant can tool for as few as 300 to 1000 parts per year, providing the tools are stored for further use.

2. Some parts require exceptionally close tolerances, and commercial fabricators cannot afford to employ the extremely close supervision necessary to meet the requirements. A captive plant can assign technicians to follow the production closely enough to obtain the critical tolerances necessary.

3. Trouble has been experienced in obtaining delivery of parts quickly. Frequently, delivery requires three to six months. A plant having deadlines to meet can expedite the process by overtime work.

How To Design Well in Transparent Plastics

Design experience inherited by engineers and designers from work with conventional engineering materials has allowed a relatively simple transition to design with opaque plastics. When designing with transparent plastics, however, the engineer or designer finds that experience passed down from work with pressed and cut glass, gem stones and older transparent sheet materials does not go far enough to allow confident design. The back surface of the material becomes more important



Underwater sightseers

Depend on GERING EXTRUDED TUBING

You'll agree that a snorkel is no better than its life-line, the tube that carries the vital supply of air to the swimmer. In both their single-tube and their "Double-Header" snorkel, Globe Rubber Products of Philadelphia, use acetate tubing from Gering's Extruded Products Division for this important task.

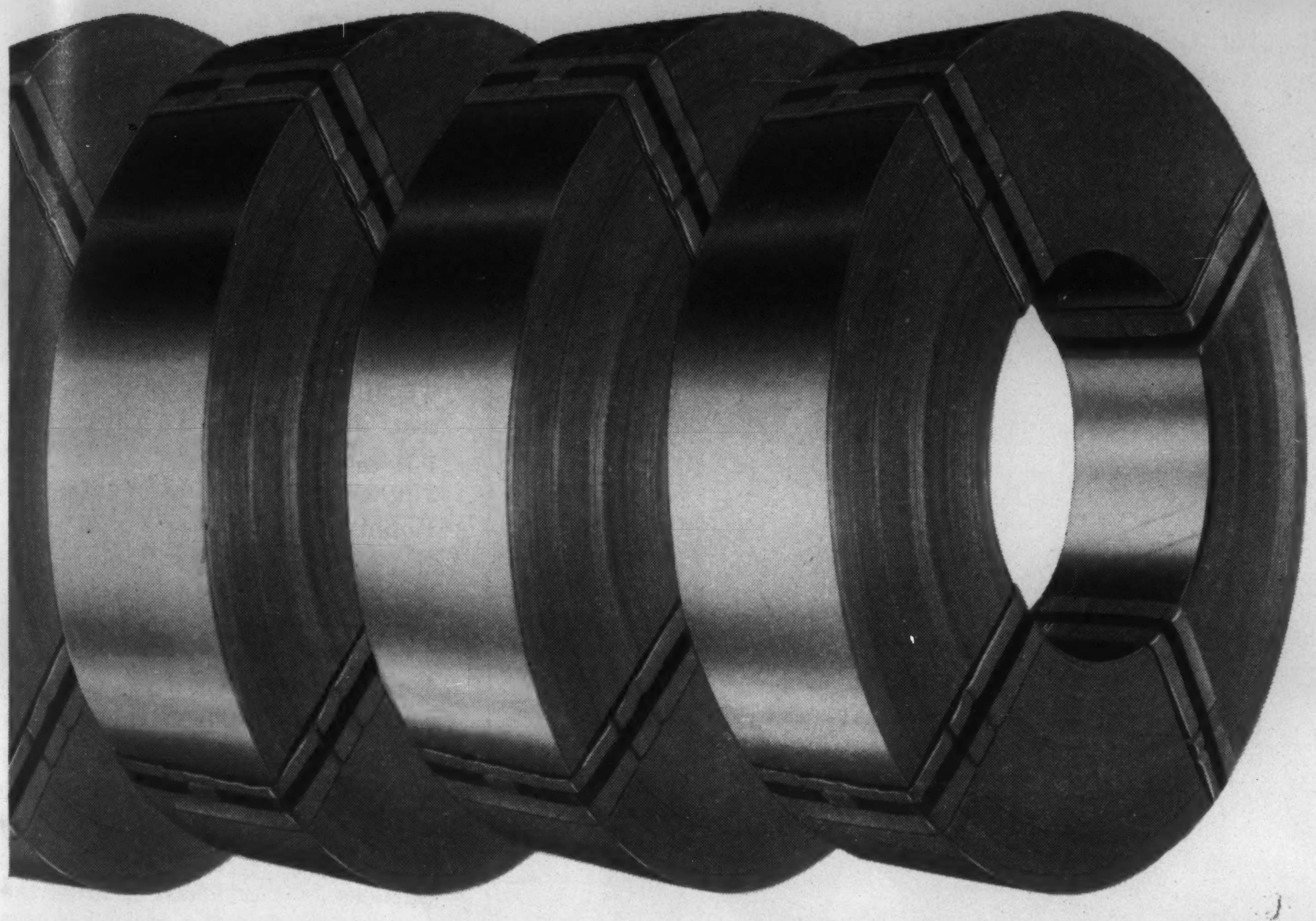
COMPLETE PRODUCTION FACILITIES!

For the finest in lightweight, durable, easily formed plastic extrusions in a complete range of thermoplastic materials, come to Gering. At your service are hundreds of dies . . . complete custom die-making . . . and a wide range of modern extrusion equipment. Why not send us your blueprint—let us bid on your next job. Find out for yourself that Gering means top quality plus dependable delivery . . . made possible by one of the most complete and efficient extrusion plants in the world!

Gering Extrudes
Polyethylene, Acetate, Butyrate; (Tenite II), Acrylic, Vinyl, Polystyrene, Ethyl Cellulose, Copolymers

Service • Quality • Dependability
GERING PRODUCTS, INC.
KENILWORTH, N. J.

VISIT OUR BOOTH NUMBER 944-945 NATIONAL PLASTICS EXPOSITION NEW YORK COLISEUM, JUNE 11TH TO 15TH
For more information, turn to Reader Service Card, Circle No. 553



for dependable deliveries of cold rolled specialty steels —call CRUCIBLE

Crucible is geared to give you *reliable, on-time deliveries* of a wide variety of cold rolled specialty steels—carbon spring, alloy strip . . . coils or cut lengths . . . in the size, finish and temper you specify.

And you're sure of *quality* from Crucible—*fine finish . . . better edges . . . improved flatness.*

So, for prompt deliveries, timed to meet your production schedules—call Crucible. And, for handy reference—mail the coupon for your free copy of Crucible's 32-page fact-filled book on cold rolled specialty steels. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

Crucible Steel Company of America
The Oliver Building, Mellon Square,
Pittsburgh 22, Pa.

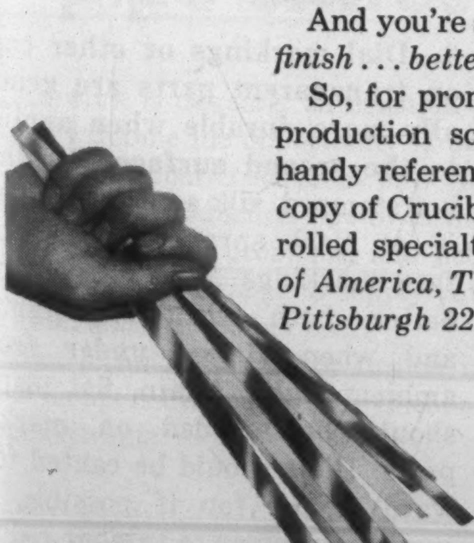
I'd like a copy of your 32-page booklet on cold rolled specialty steels.

Name____________________Title____________________

Company____

Address____

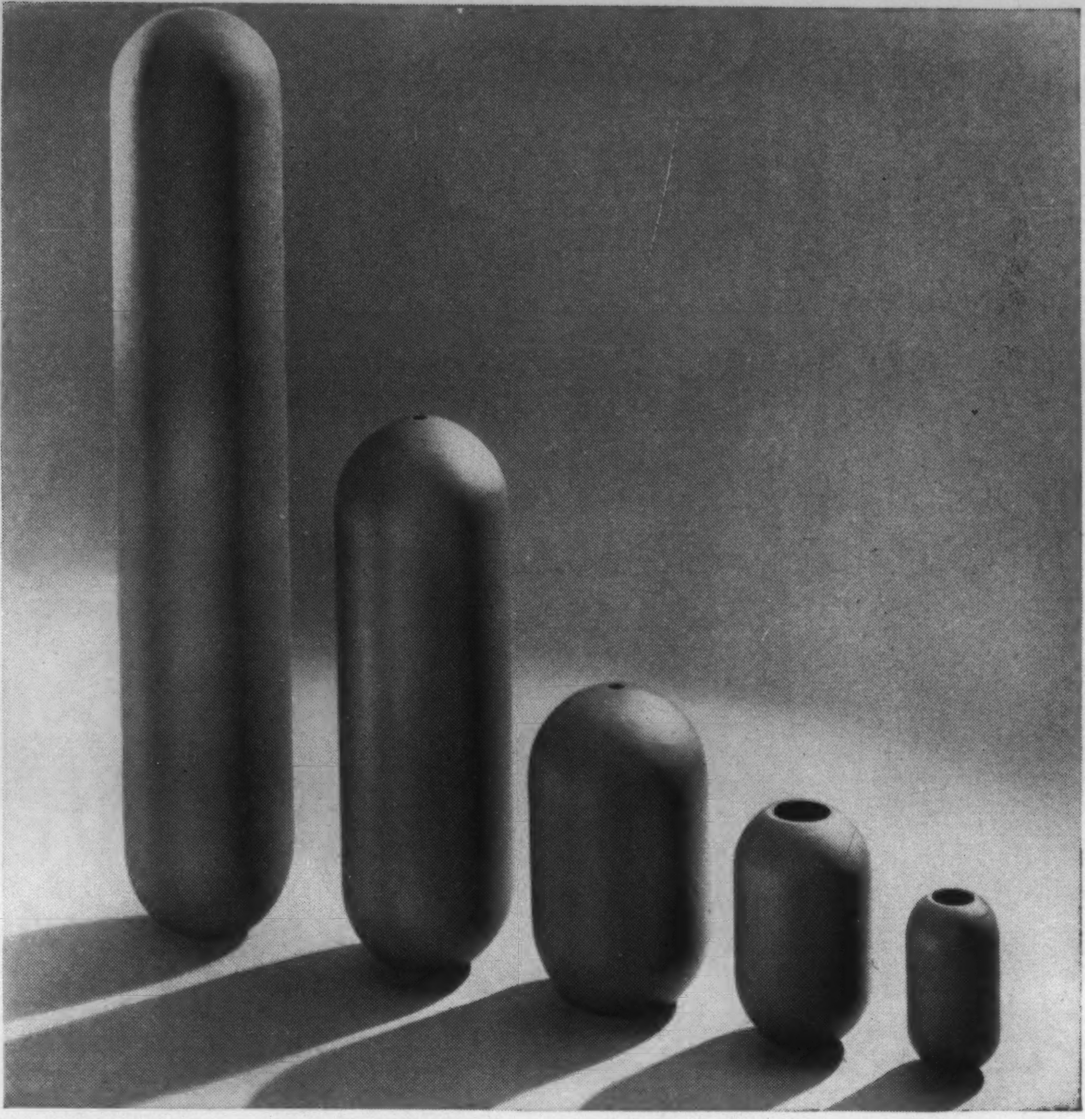
City____________________Zone______State________



CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

For more information, turn to Reader Service Card, Circle No. 444



For strength and light weight... specify Hackney seamless shells

This family of hydraulic accumulator shells illustrates two of the outstanding advantages which are yours to command when you specify Hackney seamless deep drawn shapes and shells. Strength to resist pulsations and hydraulic pressures. Light weight to reduce heft of the completed assembly.

Formed from a single sheet of metal, Hackney seamless shells can often replace heavy forged, cast or welded-pipe parts in hydraulic or pneumatic equipment. They're favorites, too, for designers of equipment for air conditioning, refrigeration, food or chemical processing. Streamlined shapes improve product appearance, and often result in lower unit costs.

Shapes may be cylindrical, spherical, conical or tapered—in a great variety of sizes and metals. Send us a sketch, and our engineers will gladly work out the details that meet your requirements.

Pressed Steel Tank Company
Manufacturer of Hackney Products
1442 South 66th St., Milwaukee 14, Wisconsin • District Offices:
52 Vanderbilt Avenue, Room 2019, New York 17 • 241 Hanna Bldg., Cleveland 15 • 936 W. Peachtree St., N.W., Room 111, Atlanta 3 • 208 S. LaSalle St., Room 788, Chicago 4 • 559 Roosevelt Bldg., Los Angeles 17 4550 Main St., Room 202, Kansas City 6, Mo. • 136 Wallace Ave., Downingtown, Pa.

Hackney
MILWAUKEE
DOWNINGTOWN IRON WORKS

CONTAINERS AND PRESSURE VESSELS FOR GASES, LIQUIDS AND SOLIDS

For more information, turn to Reader Service Card, Circle No. 368

CONTENTS NOTED

than the front, in many cases, and concealment of fasteners and related components behind the part raises tricky problems.

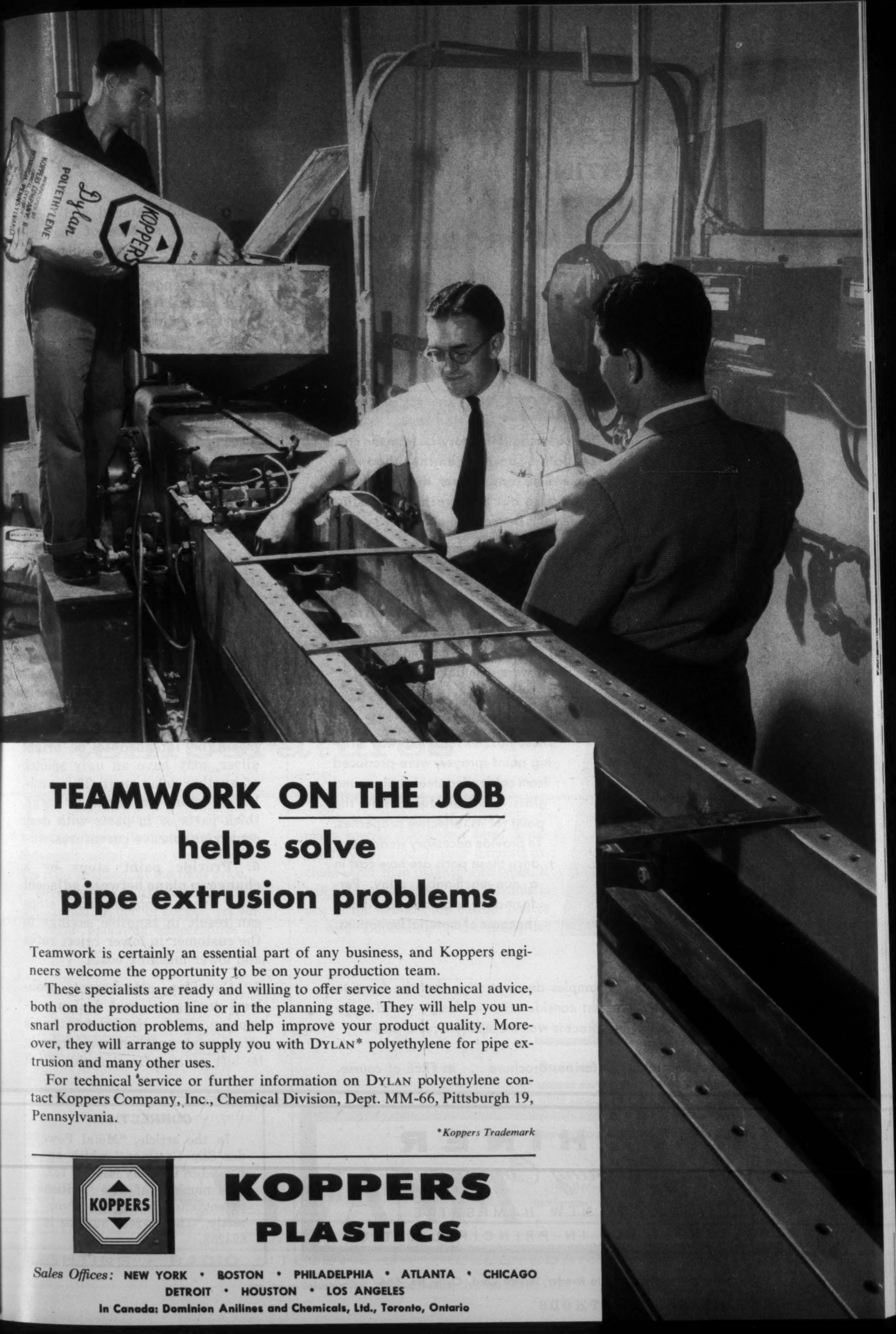
In a paper delivered at the 12th Technical Conference of the Society of Plastics Engineers and published in February's *SPE Journal,* A. M. Blumenfeld, of Rohm and Haas Co., discusses some basic design factors that should be considered in working with transparent plastics.

1. **Avoid use of flat planes wherever possible.** Even the slightest crown or curvature will substantially help to overcome erratic first-surface reflections resulting from faults in the finish. Avoiding flatness is particularly important where areas of the second surface are metallized. A flat mirrored surface shows every flaw, whereas a very slightly crowned mirrored surface reflects only a band of light.

2. **Avoid sudden changes in first surface plane.** Sudden changes of plane create lensatic or prismatic distortions of vision throughout the part. External corners should be as generously and gradually rounded as the designer can make them. The second surface is the place to express crispness of design by breaking up the area into contrasts of texture, color and form. In other words, style the second surface, not the first.

3. **Dial markings or other copy on transparent parts are generally more durable when applied to the second surface.** Whether hot stamped, silk screened, wiped-in or mask sprayed, second-surface markings tend to show up better, both when edge-lighted and when viewed under front ambient light. Again, flat planes should be avoided on marked parts. Dials should be canted forward at the top if possible, or curved concavely to further reduce reflections. On edge-lighted dials, a dark background is helpful. However, the background color should be applied to a separate

For more information, Circle No. 504



TEAMWORK ON THE JOB helps solve pipe extrusion problems

Teamwork is certainly an essential part of any business, and Koppers engineers welcome the opportunity to be on your production team.

These specialists are ready and willing to offer service and technical advice, both on the production line or in the planning stage. They will help you unsnarl production problems, and help improve your product quality. Moreover, they will arrange to supply you with DYLAN* polyethylene for pipe extrusion and many other uses.

For technical service or further information on DYLAN polyethylene contact Koppers Company, Inc., Chemical Division, Dept. MM-66, Pittsburgh 19, Pennsylvania.

**Koppers Trademark*

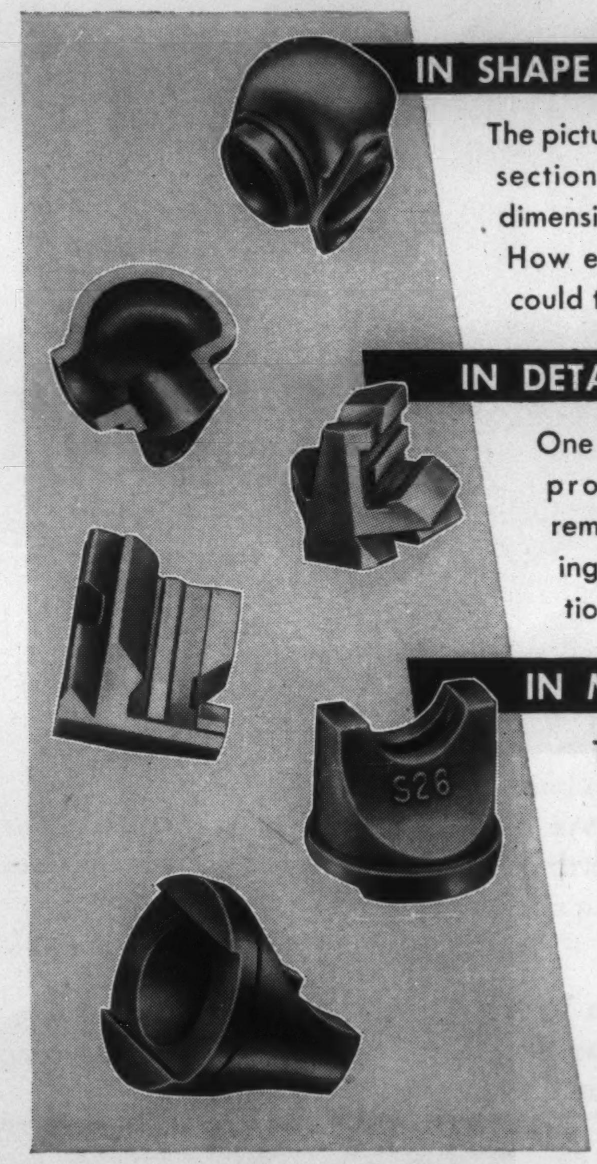
KOPPERS
PLASTICS

Sales Offices: **NEW YORK • BOSTON • PHILADELPHIA • ATLANTA • CHICAGO**
DETROIT • HOUSTON • LOS ANGELES
In Canada: Dominion Anilines and Chemicals, Ltd., Toronto, Ontario

HERE'S HOW...

INVESTMENT CASTING ANSWERS DESIGN PROBLEMS

Investment Casting is a specific production method that fills a specific function. This process offers much greater latitude in shape, detail reproduction and choice of alloy than any other process.



IN SHAPE

The picture tells the story ... from the cross section it can be seen that the inside dimensions are greater than the holes. How else but by Investment Casting could this be made in one piece?

IN DETAIL REPRODUCTION

One look quickly shows the machining problems — most of them stock removal. By using an Investment Casting 21 out of 45 machining operations were eliminated.

IN MATERIAL

These nozzles for a highway striping paint sprayer, were produced from cold rolled steel until ground glass was introduced into the paint for its reflective properties. To provide necessary wear resistance these parts are now cast in a non-machinable alloy. Performance was not sacrificed because of material limitations.

These are a few examples demonstrating that the function of the part is the first consideration in design — and — the Investment Casting process was the economical answer.

For more information ask for our brochure ... its FREE of course.

HITCHINER
Manufacturing Company
MILFORD 3, NEW HAMPSHIRE
REPRESENTATIVES IN PRINCIPAL CITIES

For more information, turn to Reader Service Card, Circle No. 564

CONTENTS NOTED

background material and not to the second surface of the clear plastic. Dark colors applied to the second surface of the transparent material tend to absorb light rays and hamper even illumination of markings farthest from the light source.

4. Second surface decorative surfaces should be in shallow relief. In thick section parts, crowns of decorative areas on the second surface should be kept shallow and returning sidewalls should be deep and should have ample draft to insure easy mold release and simple application of decorative coatings.

5. Be wary of internal reflections of colors from remote areas. If a central motif is designed in deep relief (without regard to above rules), the sight line may enter the first surface and reflect from the design theme at such a wide angle that it picks up a vivid border color. As a result, the central motif, which might be intended to be bright silver, may have an ugly splotch of another color on it. This problem is more prevalent in large, thick parts or in parts with deep convex or concave curvatures.

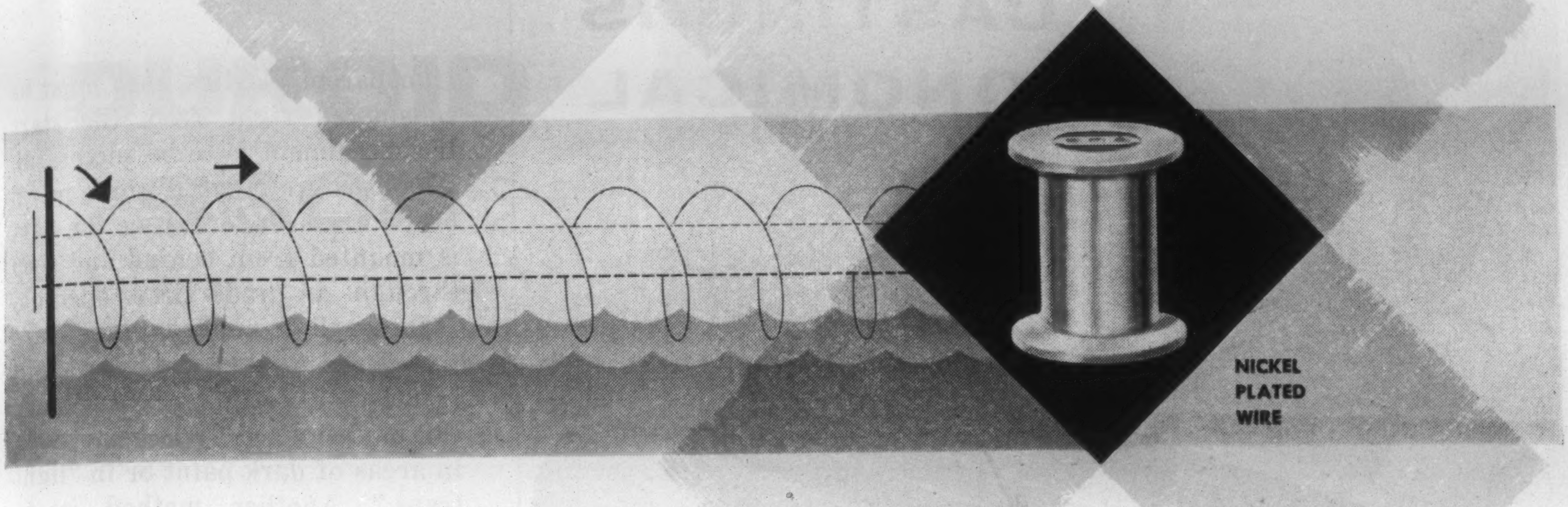
6. Provide paint stops by a change in plane between adjacent color areas. Applying such stops can result in tangible savings to the customer in lower reject rates and lower masking costs.

7. Consider attachment problems during original design conception. With opaque materials attachment problems can usually be left as an afterthought. With

CORRECTION

In the article, "Metal Powder Slip Castings," which appeared in the May issue, p 132, the number of the British patent cited was given incorrectly. The correct number is 694203.

Nickel plated copper is just one of the many special wire composites developed by Sylvania to meet exacting wire requirements.



Sylvania **composite wire** offers high conductivity at higher operating temperatures

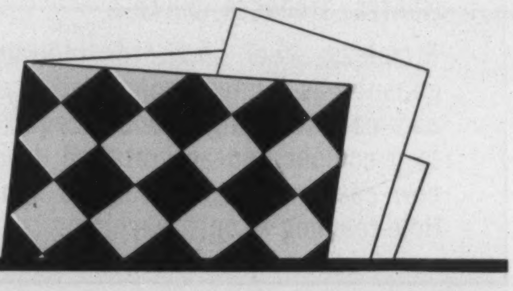
DO YOU HAVE AN APPLICATION for a high conducting wire that can withstand higher temperatures? If so, Sylvania's nickel plated wire can offer the right solution, at the right price.

Here is a wire which has conductivity approximating that of copper, yet will withstand operating temperatures up to 150° C higher than copper.

Nickel plated copper is just one of many special cold-drawn wires developed by Sylvania. If your interests include other than magnet wire types, it will help you to know that Sylvania is one of the nation's top custom platers of wire. Depending on the properties you want, Sylvania can custom plate wire in ranges from "flash" to 20% by weight in a wide range of materials and supply it in sizes from .250 to .002. Your custom wire can be clad, too, in just about any combination of materials.

PARTS
DIVISION

metal stamping · special wire · molded plastic · electronic parts



Special Wire is an important phase of Sylvania's unique service to product designers. For the complete story write for the Wire Facilities brochure. It's included in Sylvania's "Portfolio of 4-way service to designers." Address Dept. F53S.

SYLVANIA®

SYLVANIA ELECTRIC PRODUCTS INC.
1740 Broadway, New York 19, N. Y.
In Canada: Sylvania Electric (Canada) Ltd.
University Tower Bldg., Montreal

LIGHTING • RADIO • TELEVISION • ELECTRONICS • ATOMIC ENERGY

For more information, turn to Reader Service Card, Circle No. 563

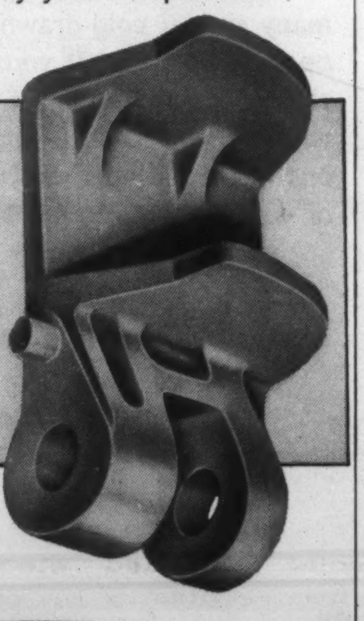
INVESTMENT CASTING IS ECONOMICAL IF...

- Performance requirements demand use of alloys that are difficult to form or machine.
- Intricate shape or unusual contours cause expensive machining, finishing, and/or assembly costs.
- Production runs too small to warrant machine set-ups.
- Part sizes are smaller than 10″ or lighter than 10 pounds.
- Realistic tolerances and inspection standards are specified.

ARWOOD engineers will gladly help you with your design and production problems. They are casting specialists. Let them study your blueprints or a sample part and save you time, effort and money.

A CASE IN POINT!
LIGHTER, STRONGER, CHEAPER

Stainless steel hinge for military ordnance component was formerly composed of a stamped bracket and machined hinge, welded together and assembled to a complicated anti-rotation device. Entire unit is now cast in one piece and is lighter and stronger. Hole-reaming is only machining required.



Write TODAY for your FREE copy of "A Critical Survey of Investment Castings", written especially for design and production engineers.

ARWOOD

ARWOOD PRECISION CASTING CORPORATION
317 West 44th Street • New York 36, N. Y.
Plants: Brooklyn, N. Y. • Groton, Conn. • Tilton, N. H. • Los Angeles, Calif.
"PIONEERS IN INVESTMENT CASTING"

For more information, turn to Reader Service Card, Circle No. 451

CONTENTS NOTED

transparent plastics, they must be considered right from the start if concealment is to be successful. Problems are reduced where metal bezels are used, or where the part is mounted from behind and seen through an undersized opening.

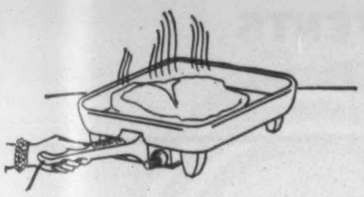
Integrally molded lugs are sometimes used on interior applications. If design permits, they can be disguised by locating them in areas of dark paint or in "light traps." Another method is to locate them in places easy to camouflage, like the centers of such letters as O, C, B, R or P, if a darker background is possible. Most lugs, however, are located near edges or on the base of returns. Under some conditions it is possible to see down through the return and this type of integral lug, can be an eyesore. By 1) rounding the external corner to a radius at least equal to the thickness of the material, 2) extending the return a length of at least three times the thickness, and 3) carrying the second surface background color around and down the return, lines of sight can be optically diverted so that the rear edge of the return and the lugs are invisible through a fairly wide viewing angle. Integral lugs, if used, should be made as large as possible for strength, and a generous fillet should be provided at the inside corners of the base.

Encouraging developmental work with adhesive-bonded attachments promises vandal-proof mastics in the near future. Use of such mastics would virtually eliminate fastener concealment problems.

(More Contents Noted on p 220)

New Tooling Plastic
Coming in July

Detailed data on a new blend of epoxy and polyamide resins that is proving successful for plastics tooling.



DUROID 5600

(REINFORCED TEFLON*)

WASHERS

Beat Torque.... Heat.... Dishwater....

Designers of a new electric frying pan located the control box underneath the handle. This position was ideal for servicing, but it meant that the control box would be completely immersed in dishwater when the pan was cleaned. One of the primary problems was to find a material that would effect a watertight seal under the three screws fastening down the control box cover. Requirements were stiff.

The material would be exposed for long periods to 450°F. It would have to compress but not extrude under the torque pressure of the screws.

Many materials were tried.

Only DUROID 5600 supplied the desired combination of resistance to heat and cold flow.

It's on the pan now — we're even fabricating the pieces.

DUROID 5600
Is another example of where Rogers has taken a good material — in this case, TEFLON — and made it better for certain applications.
If you have a product idea or improvement that requires a special material, let us go to work on it.
Combining chemicals and fibres to develop special material properties is our business.
Contact Dept. M.

* Registered trademark of Du Pont Company for its tetrafluoroethylene resin.

Material ideas for product improvement

ROGERS CORPORATION

ROGERS, CONNECTICUT

Better Parts for Better Products

PRODUCTS

DUROIDS—for Gaskets, Filters, Electronic Devices, etc.
SHOE MATERIALS—for Counters, Midsoles, Liners, etc.
ELECTRICAL INSULATION—for Motors, Transformers, Generators, etc.
PLASTICS—Special Purpose Molding Compounds and Laminates.

SERVICES

FABRICATING—Including Combining, Coating, and Embossing.
DEVELOPMENT—Research and Engineering of New Materials, Parts, and Products.

• For more information, turn to Reader Service Card, Circle No. 363

Teflon*...

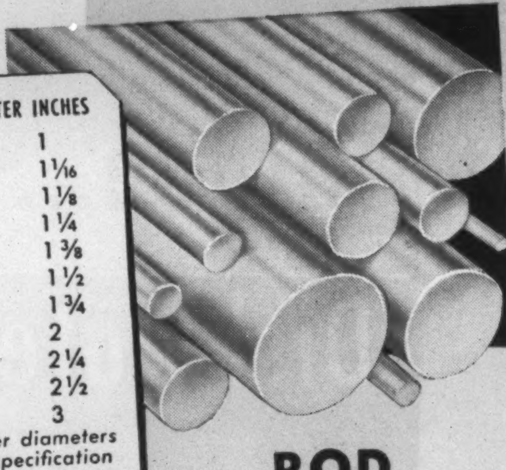
Your Best Source Is

JOHN CRANE

Thickness Inches	Nominal Size
1/16	12 x 12
3/32	18 x 18
1/8	24 x 24
3/16	36 x 36*
1/4	48 x 48*
3/8	
1/2 & Up	

* Can be furnished in 1/2 sheets

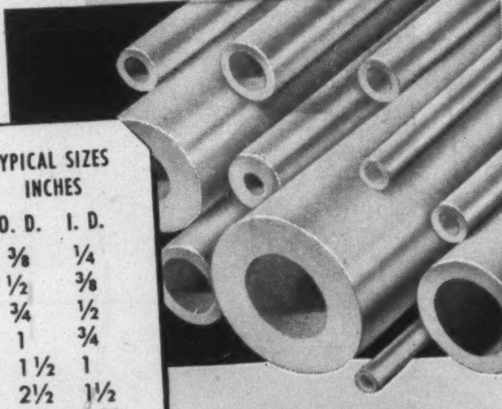
SHEET



DIAMETER INCHES	
1/4	1
5/16	1 1/16
3/8	1 1/8
7/16	1 1/4
1/2	1 3/8
9/16	1 1/2
5/8	1 3/4
3/4	2
7/8	2 1/4
	2 1/2
	3

Other diameters on specification

ROD



TYPICAL SIZES INCHES O. D.	I. D.
3/8	1/4
1/2	3/8
3/4	1/2
1	3/4
1 1/2	1
2 1/2	1 1/2
3	1 3/4

TUBING

HERE'S WHY: You can order in quantity and in a wide variety of sizes—and be certain of complete uniformity throughout. Our strict density control assures you thoroughly non-porous Teflon—free from any flaws which might possibly affect your end use or product. Dimensions are accurate to your most critical tolerances—no rejects, waste of material or loss of time. You get product purity—Teflon at its best in every one of its remarkable characteristics. Delivery is prompt—you get the quantity you want when you want it.

Since the availability of Teflon, "John Crane" engineers have worked with Industry to successfully solve innumerable problems and develop new applications. *You can benefit from their experience and know-how.*

Characteristics of Teflon

CHEMICAL
Completely inert.

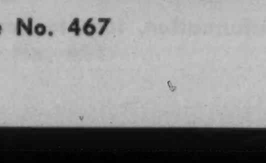
ELECTRICAL
Very high dielectric strength.
Extremely low power factor.

THERMAL
Temperature range
−300° to +500° F.

MECHANICAL
Strong, flexible, weather resistant.

LOW COEFFICIENT OF FRICTION
Absolutely non-stick.

* *DuPont Trademark*



Request full information and ask for our bulletin, The Best in Teflon.
Crane Packing Co., 6460 Oakton St., Morton Grove, Ill.,
(Chicago Suburb).
In Canada: Crane Packing Co., Ltd., Hamilton, Ont.

JOHN CRANE **CRANE PACKING COMPANY** 38 YEARS INDUSTRIAL PROGRESS

For more information, turn to Reader Service Card, Circle No. 467

CONTENTS NOTED

Design Data Needed for Aircraft Materials

In the comparatively short span of 15 years the average structural weight of aircraft has increased from about 30% of gross weight to a present value of around 40%. This increase has taken place in spite of improved materials, an increased fund of design knowledge and improved fabrication methods. To keep this ratio down, something must be done to improve structural design. A critical need exists for better design data on new and existing materials.

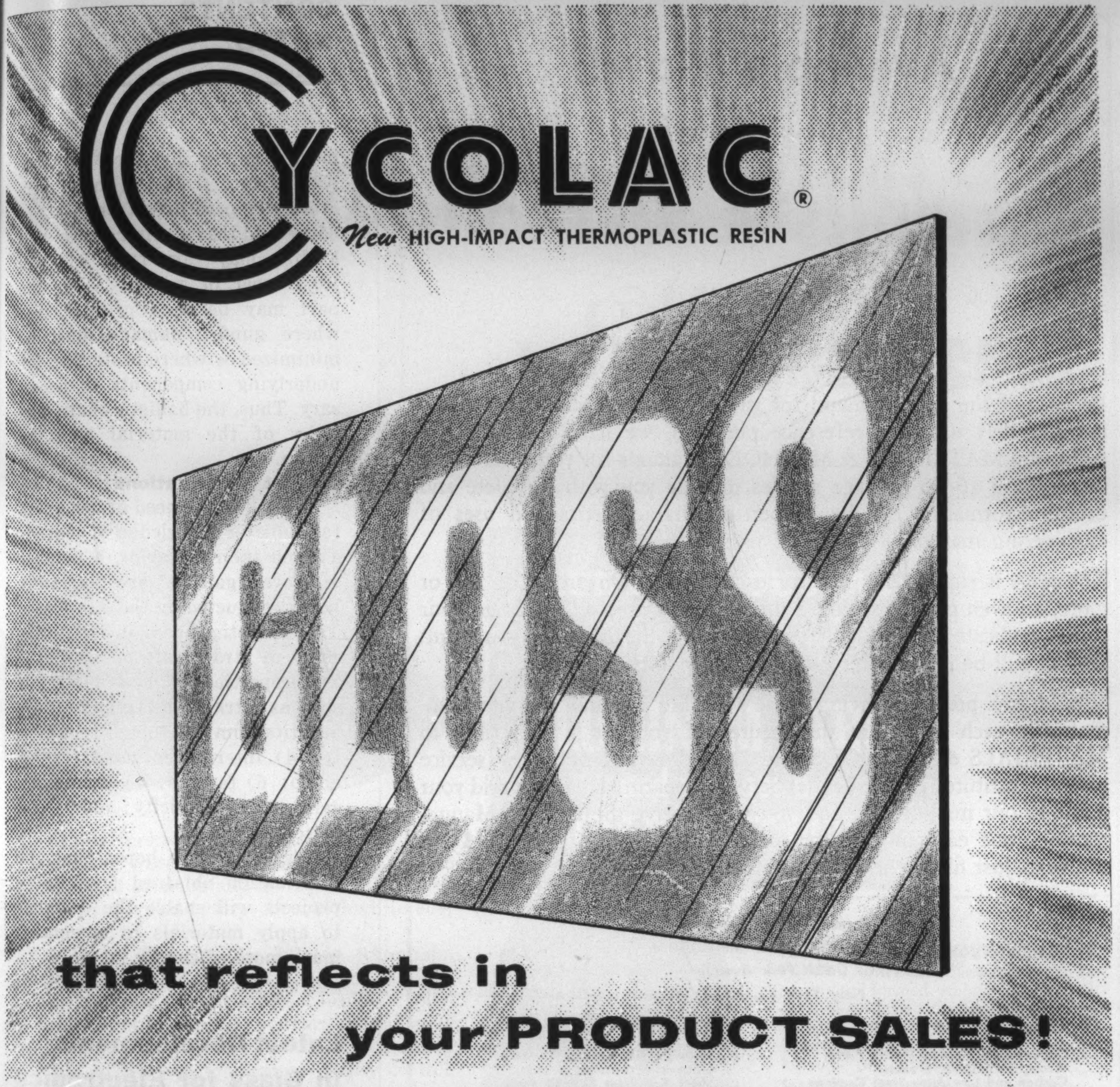
In a paper presented before the American Society of Mechanical Engineers in Chicago last November, D. A. Shinn of the Wright Air Development Center described some of the investigations being conducted by the Air Force to improve materials design data.

Design Considerations

Very few aircraft failures can be attributed solely to underdesign of the structure. The frequency of structural failures has been estimated to be one per 100,000 flying hr. In comparison, failures due to other causes have been estimated to occur between 10 and 100 times as frequently. Hence, structural weight can probably be reduced to some extent. The small number of structural failures however, makes it difficult to determine how much a part has been overdesigned and how much its weight can be reduced.

Once performance requirements have been set (temperature, life, load, etc.) it is necessary to make a general comparison of available materials for the conditions likely to be encountered. Tensile properties provide a good basis for comparison and they are usually studied first to screen out the chaff. Consideration of the various types of design (straight sheet stringer panel, thick skin, integrally stiffened panel, etc.) may reveal that a different material is most efficient for each type of construction.

Materials selection is made



CYCOLAC®

New HIGH-IMPACT THERMOPLASTIC RESIN

that reflects in your PRODUCT SALES!

THE PERFECT RESIN FOR THE MANUFACTURE OF ANY PRODUCT THAT DEMANDS . . .

- Chemical Resistance
- Lightweight
- Non-Corrosion
- Dimensional Stability
- High Impact Strength
- Machineability
- Low Brittle Point
- High Heat-Distortion

You can count on CYCOLAC for both high gloss and superior impact-resistance — outstanding for injection-molded items demanding the best in appearance and performance. Light, rigid and tough; excellent electrical properties; good dimensional stability; low creep; exceptionally low brittle point.

Get the facts . . .

WRITE TODAY FOR COMPLETE TECHNICAL LITERATURE

MARBON CHEMICAL

Division of BORG-WARNER

GARY, INDIANA

MARBON CHEMICAL . . . ***Precision Resins for Precision Made Products***

• For more information, turn to Reader Service Card, Circle No. 503

Available Now!!

Reprints of

MATERIALS & METHODS MANUALS

Because of the great demand for the well-known Manuals that are being widely used for reference purposes, we have reprinted the following MATERIALS & METHODS Manuals for your use. These outstanding 16- to 32-page articles provide you with complete and useful information on the properties, characteristics and uses of engineering materials, parts and finishes.

The price is right! Only 25¢ for each reprint. On orders of 100 or more, an even greater saving is offered—20¢ apiece. To obtain your copies, indicate in the handy coupon below the Manuals you want. Orders will be filled as long as the supply lasts.

Would you prefer receiving these valuable Manual reprints automatically each month in the future? If you are a subscriber to MATERIALS & METHODS, then avail yourself of a new service recently instituted by our Reader Service Department. Let us add your name to our mailing list, and you will receive the next 12 Manual reprints, one each month, for the same reasonable price of $3.00 per year. Just fill in the coupon below and mail it to:

Reader Service Department
MATERIALS & METHODS
430 Park Avenue
New York 22, New York

Quantity

....Compression Molded Plastic Parts
....Wrought Phosphor Bronzes
....Carbon and Low Alloy Steel Castings
....Carburizing of Steels
....Malleable Iron Castings
....Wood and Wood-Base Materials
....Surface Hardening of Steels and Irons
....Selecting Metal Cleaning Methods
....Engineering Coppers
....High-Strength, Low-Alloy Steels
....Sandwich Materials
....Rigid Polyvinyl Chloride Plastics
....Mechanical Properties & Tests of Engineering Materials
....How Nuclear Radiation Affects Engineering Materials
....Close Tolerance Castings
...Age Hardening of Metals
....Adhesive Bonding
....Clad and Precoated Metals

Quantity

....Wrought Non-Leaded Brasses
....Silicones—Properties & Uses
....Short Run Press Formed Parts
....Metals for Short Time Service at High Temperature
....Finishes for Plastics
....How to Select a Wrought Steel
....Impact Extruded Parts
....Finishes for Metal Products
....Nodular or Ductile Cast Irons
....Corrosion: How It Affects Materials Selection and Design
....Industrial Textile Fibers
....Wrought Aluminum Alloys
....Fabricated Metal Parts
....Pressure Sensitive Tapes
....New Stainless Steels
....Improve Quality, Reduce Costs Through Better Materials Selection
....Foam Plastics

Name ....Title ....
Company ....
Street ....
City ....State ....

☐ Yes, I am a subscriber to MATERIALS & METHODS and would like to be put on your mailing list to receive each future Manual, when reprinted. Please start it with the.................issue. Upon receipt of your invoice, I will pay $3.00 for a year's supply.

CONTENTS NOTED

more complex by the fact that parts may be called upon to operate at temperatures from —65 to 350 F and that strain rates during loading may vary from 0.005 to 1.0 in. per in. per sec. Also, the part may be in a critical area where gunfire damage must be minimized or where protection for underlying components is necessary. Thus, the ballistic characteristics of the material must be known.

Current investigations

To satisfy the need of designers for a better knowledge of materials and their behavior, a number of investigations are currently being conducted by the Air Force. The investigations include: 1) effect of strain rate on strength; 2) properties of new materials such as ultra high strength steels and titanium; 3) notch sensitivity; 4) intermittent heating; 5) creep; 6) fatigue; 7) cumulative damage; 8) plasticity; and 9) ballistics.

The Air Force hopes that the information obtained from these projects will enable the designer to apply materials to structures much more efficiently.

Latest Developments in Glass for Electronics

The fact that glass is an engineering material that can be produced with a wide variety of characteristics to suit specific requirements is often overlooked.

In general, glass is strong in compression and shear, and weaker in tension, although tensile strength can be increased substantially by special treatment. Hardness usually ranges between 330 and 570 Knoop. Glasses are available with linear coefficients of thermal expansion ranging from 3.0 to 70 x 10^{-7} per deg F. Though glasses are classified as insulators, their specific volume resistance can be varied many fold, depending on chemical composition.

With these general physical

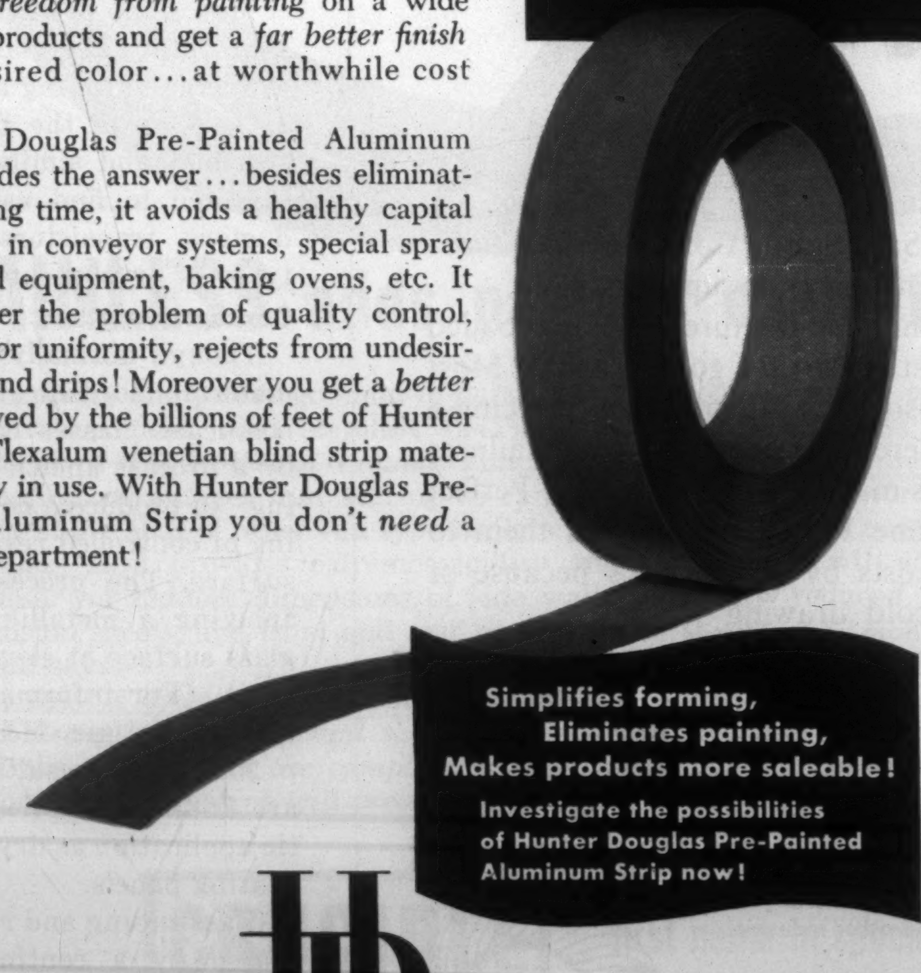
You don't have to PAINT

when you use

HUNTER DOUGLAS
Pre-painted
ALUMINUM STRIP
and you get a
BETTER PRODUCT FINISH!

Manufacturers using strip stock can now enjoy *complete freedom from painting* on a wide variety of products and get a *far better finish* in any desired color . . . at worthwhile cost savings!

Hunter Douglas Pre-Painted Aluminum Strip provides the answer . . . besides eliminating handling time, it avoids a healthy capital investment in conveyor systems, special spray booths and equipment, baking ovens, etc. It ends forever the problem of quality control, lack of color uniformity, rejects from undesirable runs and drips! Moreover you get a *better* finish, proved by the billions of feet of Hunter Douglas' Flexalum venetian blind strip material already in use. With Hunter Douglas Pre-Painted Aluminum Strip you don't *need* a painting department!



Simplifies forming,
Eliminates painting,
Makes products more saleable!
Investigate the possibilities
of Hunter Douglas Pre-Painted
Aluminum Strip now!

FORMS READILY WITHOUT DAMAGE TO PAINTED SURFACES—Now parts can be readily roll formed, embossed, stamped, even *deep-drawn through several successive stages* without marring, cracking or scratching this hard, bright, lustrous, pre-painted surface!

MAXIMUM ADHESION—Chemically prepared surfaces are specially primed, followed by a second coat of enamel—with each coat individually baked. Bond is exceptionally strong. Edges cut clean and sharp, are free from flaking and chipping.

EXTERIOR DURABILITY COMPARABLE TO AUTOMOTIVE FINISHES—Unusually color fast in sunlight, resistant to heat and cold; successfully passes extreme 500 hour, 90°, 20% salt spray test with no lifting or blistering.

WIDE COLOR SELECTION—Colors to harmonize or contrast with other décor.

STOCK SPECIFICATIONS—If your production can use mill quantities (20M lb./minimum) in widths up to 8", nominal thicknesses, get our quotations.

Hunter Douglas HD Aluminum Corporation

Detroit Sales Engineering Office:
16722 E. Warren Ave., TUxedo 2-0232

HUNTER DOUGLAS ALUMINUM CORPORATION • DEPT. MM6, RIVERSIDE, CALIFORNIA, OVERLAND 3-3030

KEYSTONE SPRING WIRE

SASH SPRING COSTS CUT!

Shaffer Sash Spring Co.
Des Plaines, Illinois
reports . . .

Long life—satisfied customers . . . and 50% lower production costs! These are the gains Shaffer Sash Spring Co. reports, using Keystone Spring Wire. Each year they supply millions of balance springs used in the manufacture of spring loaded window sash. Keystone Wire is standard for good reasons. Most important, Shaffer keeps their customers satisfied by producing a precision, high quality spring. There have been no fatigue failures since the first shipments of springs made of Keystone Wire. Perfect forming characteristics of Keystone Wire have enabled them to increase production and lower costs by 50%. That's because of Keystone's unique method of cold drawing *after* galvanizing. Coating is dense and smooth. Forming is consistent—free from flaking.

SEE YOUR KEYSTONE WIRE SPECIALIST

Keystone does not make springs . . . but does supply many leading companies with quality Spring Wire for better springs, lower production costs . . . and satisfied customers. High carbon and manganese steel spring wire—hard drawn, spheroidized annealed and music wires—are available in Keystone quality to match your spring needs. Also wire for Cold Heading and other industrial uses. Your inquiries are invited!

KEYSTONE STEEL & WIRE COMPANY, Peoria 7, Illinois

KEYSTONE WIRE for Industry

For more information, turn to Reader Service Card, Circle No. 578

properties in mind, W. H. McKnight, of Corning Glass Works, discusses a variety of newer types of glass and their application in electronic work in a paper delivered in April before the Great Lakes District meeting of the American Institute of Electrical Engineers.

High purity silica glass

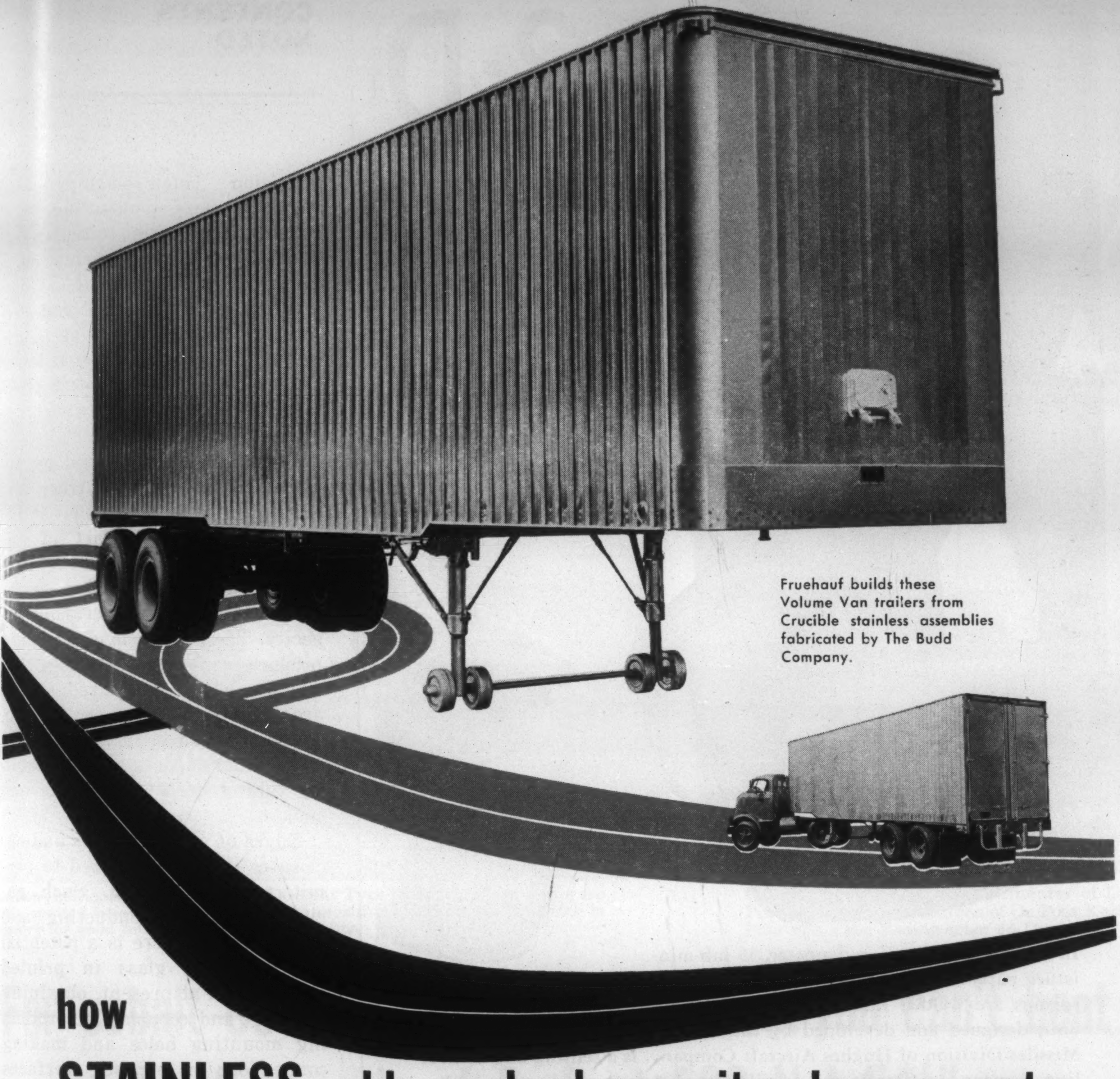
By a recently developed patented process, fine quality, clear, high purity silica glass can be produced with a low coefficient of thermal expansion of 3.1×10^{-7} per deg F. This coefficient makes the material indestructible by thermal shock; it can be plunged white-hot into ice water without damage. Its high melting point permits continued use at 1800 F and intermittent use at temperatures up to 2500 F. It has a high degree of homogeneity and a low attenuation constant, making it suitable for ultrasonic delay lines. The material is also available in boule form in sizes up to 18 in. dia and 6 in. thick.

McKnight predicts that in the near future the glass will also be available in tubing and cane form, as well as in the form of trays, crucibles and similar items. It is expected to find use in semiconductors, transistors, and similar types of crystal components.

Conductive glass

Though normally an insulating material, borosilicate and aluminosilicate glasses can be treated by a process known as "E-C coating" to produce a conductive coating of controlled resistivity on the surface. The process consists of applying a metallic oxide to the glass surface at elevated temperatures. (For information on other techniques, see M&M, May '56, p 252). The resultant materials are finding industrial and domestic application as drying and space heating panels.

Glass tubing and rod can be E-C coated by a continuous process and subsequently cut into proper lengths. Such a material can be used in precision resistors. It can also be used in metallic film type



Fruehauf builds these Volume Van trailers from Crucible stainless assemblies fabricated by The Budd Company.

how
STAINLESS adds payload capacity—lowers costs

Cargo capacity and profits go hand-in-hand in the transportation field. And stainless steel's high-strength gives this Fruehauf *Volume Van* trailer construction advantages that add up to carrying capacity above that of other van type trailers.

Stainless steel provides extreme rigidity and toughness, yet reduces dimensions of side walls, roof tension sheets, and front and rear panels. As Fruehauf says:

"Not only is there a gain in cubic capacity as well as strength, but an actual saving in weight so that the net result of the complete design is a transportation unit which will provide the highest possible return on the initial investment."

And stainless lasts indefinitely. In fact, there's a tradition in the industry that "no stainless steel trailer has ever worn out." For stainless resists wear, fights corrosion, takes a lot of punishment before it will scratch or dent. Maintenance is greatly reduced.

Should your product use stainless? It may be the answer to greater efficiency, lower costs, a more attractive product for you, too. Ask your local Crucible representative, or write *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

CRUCIBLE first name in special purpose steels

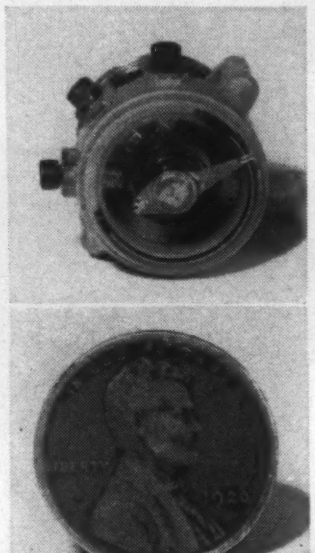
Crucible Steel Company of America

Canadian Distributor — Railway & Power Engineering Corp., Ltd.

For more information, turn to Reader Service Card, Circle No. 386

HOW 3-D MICRO-VISION HELPS FAIRCHILD

manufacture world's tiniest production-run potentiometer



In a case less than ½" in diameter, 35 sub-miniature parts are precision-assembled; hair-thin springs are welded into fine slots. This tiny unit, designed and developed by the Guided Missiles Division of Hughes Aircraft Company, is a sensing and controlling element for aircraft and missiles; critical tests must assure highest mechanical and electrical efficiency.

Fairchild Camera and Instrument Corporation attributes the efficient mass-production of this unit to the use of Bausch & Lomb Stereomicroscopes—in assembly, inspection, and quality control. "Operators have both hands free and use both eyes to obtain normal, three-dimensional vision magnified to the required power—with high efficiency and operator comfort."

Write for FREE Copy of this Exclusive 3-D Micro-Vision Data Book

- See actual stereo views!
- Know *how* and *where* to use Stereomicroscopes!
- Fit exact model to job needs with Selector-Chart!

Bausch & Lomb
Stereomicroscopes
3-D

WRITE TODAY for Data Book D-15. Bausch & Lomb Optical Co., 83306 St. Paul St., Rochester 2, N.Y.

BAUSCH & LOMB
SINCE B&L 1853

America's only complete optical source . . . from glass to finished product.

CONTENTS NOTED

precision potentiometers with metal wipers contacting E-C coated concentric circular-segmented resistive elements on a glass disk. E-C coated glass also can be used for thermal and electrostatic shields. As an antistatic shield it is very effective at lower frequencies and moderately effective in the microwave region.

Metallized glass

Glass can be metallized by applying metal to the surface and subsequently firing so that it becomes an integral part of the glass. Greater metal thicknesses can be built up by plating copper to increase current carrying capacity. The process is also used to produce cane-form electrical inductors, where metallized spirals are applied to cane or tubing. These are used in such equipment as trimmer capacitors, permeability tuning units, coil forms and chokes.

Edges of glass windows and enclosures can be metallized to permit solder mounting. Such enclosures are nonconducting and nonmagnetic. There is a potential for metallized glass in printed circuits but, at present, obtaining accuracy and economy in producing mounting holes and making connections on opposite surfaces are major problems.

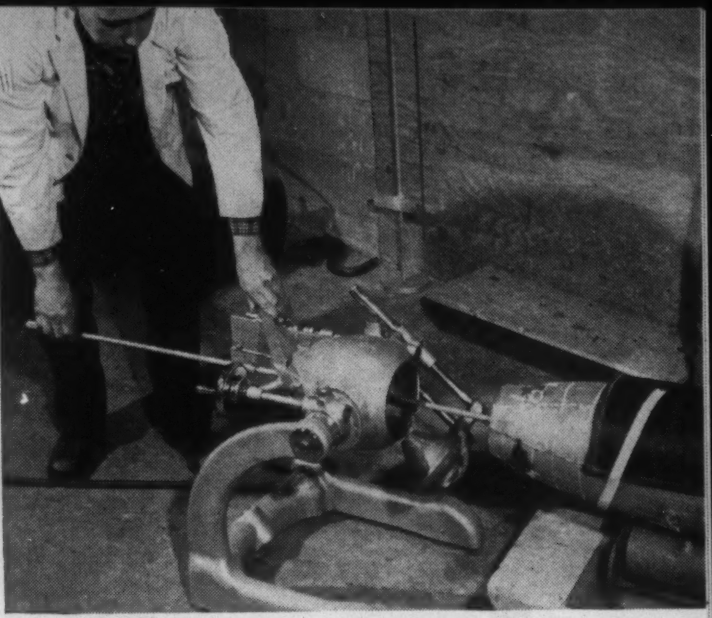
Glass can also be coated by vapor metallizing. However, it is generally costly, and is done only on precision finished items such as attenuator plates and other units used in microwave applications.

Glass-to-metal seals

Suitable glasses have been developed for sealing with a long list of metals and alloys. Normal criteria for good seals are: 1) wettability of the metal or its adherent oxide coating by the glass at sealing temperatures; 2) a relatively close match in linear coefficients of expansion between the "set-point" of the glass and the temperature at which the seals will operate; 3) freedom from high temperature chemical reaction between the constituents; and

For more information, Circle No. 448 ➤

Technician positions holder containing Du Pont Type 506 X-ray Film. Flaws are quickly spotted because Type 506 has high sensitivity, plus fine grain, which is necessary for good interpretation of radiographs.



Jo Drechsler inserting an isotope into center of an experimental casting. The flexible film holder, loaded with Du Pont 506 X-ray Film, is wrapped around top of the casting.

Technical Representative Bob Parmenter of Du Pont discusses high resolution of Du Pont X-ray Film with Chief Radiographer Jo Drechsler.

"For cobalt 60 or x-ray examination . . . you can't beat the fine grain of Du Pont 506 N. I. F.*!"

Chief Radiographer Jo Drechsler, Riverside Foundry, tells why:

Riverside Foundry, Bettendorf, Iowa, one of the largest independent producers of grey iron and steel castings, is a pioneer in the use of radioactive isotopes for radiographic examination.

"Our lab makes many thousands of x-ray and cobalt 60 shots a year," says Chief Radiographer Jo Drechsler. "Careful examination is given every casting we produce, including those for automotive and crawler-tractor parts, as well as special castings made for the Government.

"With such a wide variety and heavy volume of parts to inspect, we use dependable Du Pont Type 506 and Type 510 Industrial X-ray Films . . . exposing with cobalt 60 and x-ray. These rugged, fast-handling films consistently produce high-quality radiographs, keep exposure times to a minimum and resist abrasion marks due to rough handling. In addition, the packaging without interleaving paper speeds cassette loading and increases darkroom efficiency.

"In our use of cobalt 60, we rely on Du Pont 506 because of its speed, wide latitude and good contrast . . . especially when we expose castings which vary in section thickness. Du Pont Films have the range we need with the difference of conformity and design in our castings.

"To keep pace with high production quotas," concludes Mr. Drechsler, "we must have a fast-handling film that can produce consistently good radiographs. Our requirements are rigid, but Du Pont X-ray Films meet them all!"

FOR MORE INFORMATION, write or call the nearest Du Pont Sales Office (listed below) or the Du Pont Company, Photo Products Department, Wilmington 98, Delaware. In Canada: Du Pont Company of Canada Limited, Toronto.

SALES OFFICES

Atlanta 8, Ga. ....805 Peachtree Bldg.
Boston 10, Mass. ....140 Federal Street
Chicago 30, Ill. ....4560 Touhy Avenue, Lincolnwood
Cleveland 16, Ohio ....20950 Center Ridge Road
Dallas 7, Texas ....1628 Oak Lawn Avenue
Los Angeles 38, Calif. ....7051 Santa Monica Blvd.
New York 11, N. Y. ....248 West 18th Street
Philadelphia 2, Pa. ....225 South 15th Street
Export .... Nemours Bldg., Wilmington 98, Delaware

*N. I. F.—Non-Interleaved Film

DU PONT

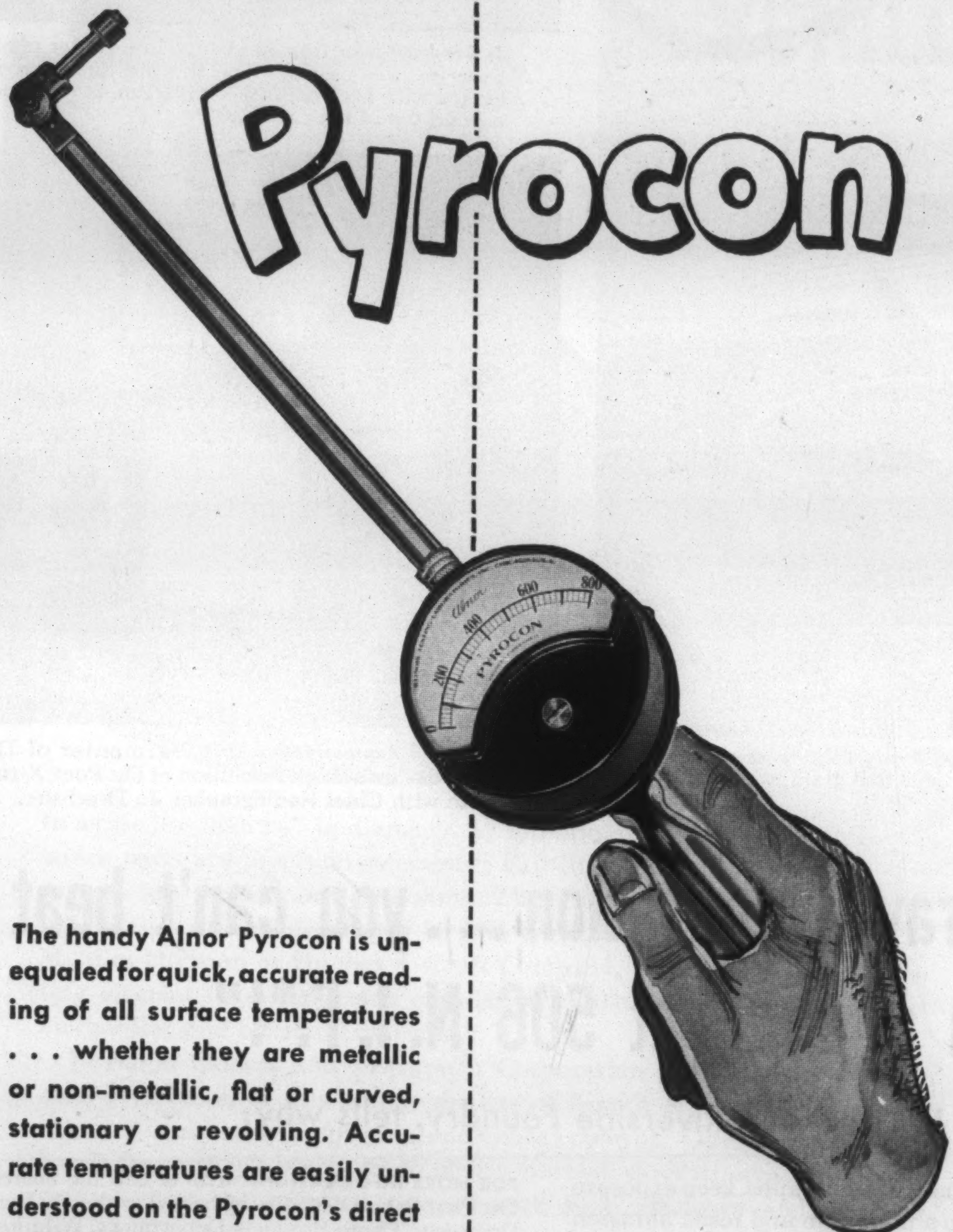
REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

DU PONT X-RAY PRODUCTS

FILMS • "PATTERSON" SCREENS • CHEMICALS

Take surface temperatures quickly, accurately... with the



The handy Alnor Pyrocon is unequaled for quick, accurate reading of all surface temperatures . . . whether they are metallic or non-metallic, flat or curved, stationary or revolving. Accurate temperatures are easily understood on the Pyrocon's direct reading scale face . . . without interpolation or need of conversion tables. A wide selection of thermocouples and extension arms permits adaptation to many types of service. For complete details and prices, send for Bulletin No. 4257. Illinois Testing Laboratories Inc., Room 522, 420 N. LaSalle Street, Chicago 10, Ill.

Alnor

PRECISION INSTRUMENTS FOR EVERY INDUSTRY

For more information, turn to Reader Service Card, Circle No. 390

CONTENTS NOTED

4) application of good design principles.

In basic design, glass-to-metal seals are divided into two major categories. The high expansion group consists of combinations of the softer lead and lime types of glasses with metals such as platinum, Dumet, Sylvania No. 4, chromium iron and cold rolled steels. The lower expansion group contains combinations of materials whose coefficients of linear expansion are less than 33 x 10^{-7} per deg F. These include borosilicate type glasses combined with tungsten, molybdenum or low expansion alloys of nickel, cobalt, chromium and iron. This latter group normally withstands higher temperatures and is more thermally stable.

Other new developments

Soft glasses—A series of relatively soft glasses called soft-sealing or solder glasses has been developed recently. They are designed for sealing to metals at temperatures lower than those encountered with conventional glass-to-metal sealing techniques. These glasses are used principally to prevent heat distortion of sealed components, to provide a hermetic joint that can be taken apart easily, or because one or more of the components involved is unable to withstand high temperature sealing. Normally parts to be assembled by this method are supplied with solder glass preglazed on the edges to be joined. Then, only enough heat to soften this glass need be applied.

Improved tensile strength—The relatively low tensile strength of normally annealed glass can

Titanium Powder Parts

Coming in July

The first comprehensive story on this subject. Powder metallurgy techniques are particularly advantageous for titanium because of the reduction in scrap loss. Savings of up to 25% compared to forging have been achieved.

HARSHAW **Nubrite**

bright nickel plating process

long operation without treatment

Other outstanding advantages are:

BRIGHT OVER WIDE RANGE
from a few amperes/ft.^{2}
to well over 100 amperes/ft.^{2}

HIGH TOLERANCE to common impurities

HIGHLY RECEPTIVE to chrome

EXCELLENT LEVELING

BETTER BRIGHTNESS with thinner deposits.

SIMPLE OPERATION and CONTROL
Plates brightly from 120°F to 155°F.
pH can vary over a wide range.
Liquid addition agents.

REMAINS DUCTILE AFTER LONG OPERATION

For additional information contact the Harshaw office nearest you.

THE HARSHAW CHEMICAL CO.
1945 East 97th Street • Cleveland 6, Ohio

Chicago 32, Ill. • Cincinnati 13, Ohio • Cleveland 6, Ohio • Houston 11, Texas • Los Angeles 22, Calif.
Detroit 28, Michigan • Philadelphia 48, Penna. • Pittsburgh 22, Penna. • Hastings-On-Hudson 6, N. Y.

• For more information, turn to Reader Service Card, Circle No. 405

speed

YOUR PRODUCTION
AT LOWER COST
WITH—

WYCKOFF
Cold Drawn CARBON & ALLOY
WIDE
FLATS
UP TO 2″ x 12″

Wyckoff Precision Wide Flat Sections are cold drawn to close tolerances and will definitely reduce your machining and assembly costs for gauges, gigs and fixtures, machine tool bases, die plates, and other heavy machinery parts.

WYCKOFF
QUALITY CONTROL
Insures

- Accuracy of Section
- Square Corners to Your Needs
- Straight Edges
- Smooth Uniform Surfaces
- Furnace Treatment to Your Specifications

SPECIALISTS IN COLD FINISHED STEELS EXCLUSIVELY

WYCKOFF STEEL CO.
GENERAL OFFICES:
Gateway Center, Pittsburgh 30, Pa.
Branch Offices in Principal Cities
Works: Ambridge, Pa. • Chicago, Ill.
Newark, N.J. • Putnam, Conn.

WYCKOFF STEEL PRODUCTS—Carbon and Alloy Steels • Turned and Polished Shafting • Turned and Ground Shafting • Wide Flats up to 12″ x 2″ • All types of furnace treated Steels

For more information, turn to Reader Service Card, Circle No. 532

be increased by a tempering operation that induces internal strains sufficient to offset initial surface weaknesses. Methods of surface treatment to increase initial strength have been known for some time. However, until recently, improvements have been of only a temporary nature. New techniques now under development promise to provide a solution to this problem.

Special uses for glass

Glass is found in many intriguing special applications. Some of the more interesting are:

1. Molten glass can be used as a high temperature lubricant.

2. Carbonyl type irons properly treated and bonded in a glassy matrix provide a ferromagnetic material with good permeability, low loss factor, and resistance to temperatures below which permanent changes in iron are recognized as existing.

3. Glass capacitors have been fabricated consisting of alternate layers of metal foil and thin glass ribbon, interlaced to provide desired capacitative values.

Evaluation of Plastics for Car Bodies

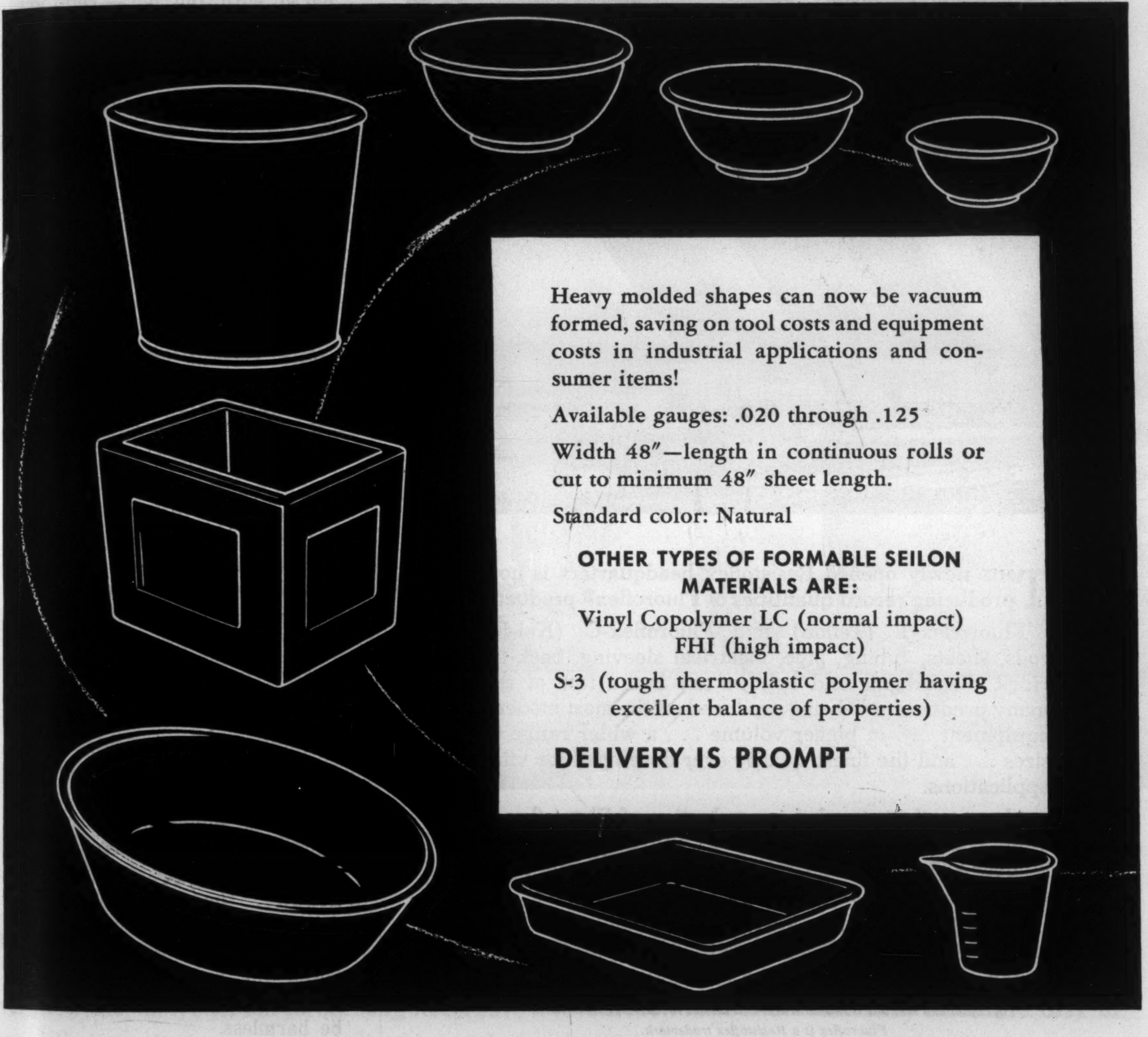
It would be impossible to enumerate every desirable quality an automobile body should possess. It is important, however, to determine those characteristics of a body material that relate directly to a need or purpose in its use. Once these characteristics have been determined, they provide a yardstick by which the suitability of a new material such as reinforced plastics, can be measured.

With such a yardstick in mind J. G. Coffin, of GM's Chevrolet Motors Div., discussed the advantages and limitations of reinforced plastics before the 11th Annual Meeting of the Reinforced Plastics Div. of The Society of the Plastics Industry. The plastic discussed is the same as that used for the first production sports car

Announcing

THE NEW FORMABLE

SEILON® POLYETHYLENE



Heavy molded shapes can now be vacuum formed, saving on tool costs and equipment costs in industrial applications and consumer items!

Available gauges: .020 through .125

Width 48″—length in continuous rolls or cut to minimum 48″ sheet length.

Standard color: Natural

OTHER TYPES OF FORMABLE SEILON MATERIALS ARE:

Vinyl Copolymer LC (normal impact)
FHI (high impact)
S-3 (tough thermoplastic polymer having excellent balance of properties)

DELIVERY IS PROMPT

Seiberling Plastics Division is adaptable to customers' requests. We will welcome the opportunity to consult with you on individual specifications of properties, gauges, colors and finishes for your products.

SEIBERLING RUBBER COMPANY
PLASTICS DIVISION

Plastics Division **SEIBERLING RUBBER COMPANY**

NEWCOMERSTOWN, OHIO • PHONE 8-8304

• For more information, turn to Reader Service Card, Circle No. 497

New plant now filling big demand for Teflon® and Kel-F® products

THIS newly opened Resistoflex headquarters is now producing record quantities of Fluoroflex® products.

Fluoroflex-T (Teflon) and Fluoroflex-C (Kel-F) rods, sheets, tubing, pipe, electrical sleeving, back-up rings, diaphragms and bellows are but a few of the many products now being produced on the most modern equipment . . . in bigger volume . . . a wider range of sizes . . . and the finest quality ever developed for vital applications.

Also greatly expanded is production of Fluoroflex-T hose . . . the *original* Teflon hose . . . the only one proved by over 3 years service and now so widely specified for aircraft and tough industrial applications.

More than ever now, Resistoflex is prepared to give you reliable service. Send for data or for quotations on your needs in Teflon and Kel-F products.

®Teflon is a DuPont trademark. Kel-F is an M. W. Kellogg trademark. Fluoroflex is a Resistoflex trademark.

20 years of service to industry

RESISTOFLEX

CORPORATION • Roseland, N.J. Western Plant: Burbank, Calif.

Warehousing Distributors: Western Fibrous Glass Products, Los Angeles, Calif. • F. B. Wright Co., Detroit Mich. • Colonial Kolonite Co., Chicago, Ill. • Industrial Safety Supply Co., Hartford, Conn. • Lone Star Rubber Co., Houston, Tex. • Flow Products Inc., Chicago, Ill.

For more information, turn to Reader Service Card, Circle No. 571

CONTENTS NOTED

having a reinforced plastics body. The material is a matched die-molded laminate consisting of 40% glass (as mat or preform), 45% polyester resin and 15% mineral filler.

When the new material is compared with the old — reinforced plastics vs steel — apparent inadequacies exist in reinforced plastics. Proper design can make some of these limitations insignificant; on the other hand, some apparently unimportant shortcomings can prove to be serious.

Plastics vs steel

Steel is inherently between two and three times stronger than reinforced plastics. However, when plastics are used in thicker sections (0.10 in. vs 0.036 in. for steel) over-all strength of the sheet or panel is actually greater than that of the corresponding steel part. Greater thickness also provides sufficient flexural rigidity. Although the flexural modulus of the plastic is only 1.3×10^6 psi, as against 30×10^6 psi for steel, stiffness in bending of the thicker plastics sections is almost exactly equivalent to that of the conventional steel section.

Tensile rigidity is another story. The greater thickness of the plastic does not even come close to nullifying its deficiency in modulus. Because of the magnitude of the difference in stiffness, high deflections might be expected in some cases, e.g. in structural areas of box section design. Actually, however, the vehicle is under dynamic load conditions, and if greater static deflections are allowed for during assembly, the lack of tensile rigidity proves to be harmless.

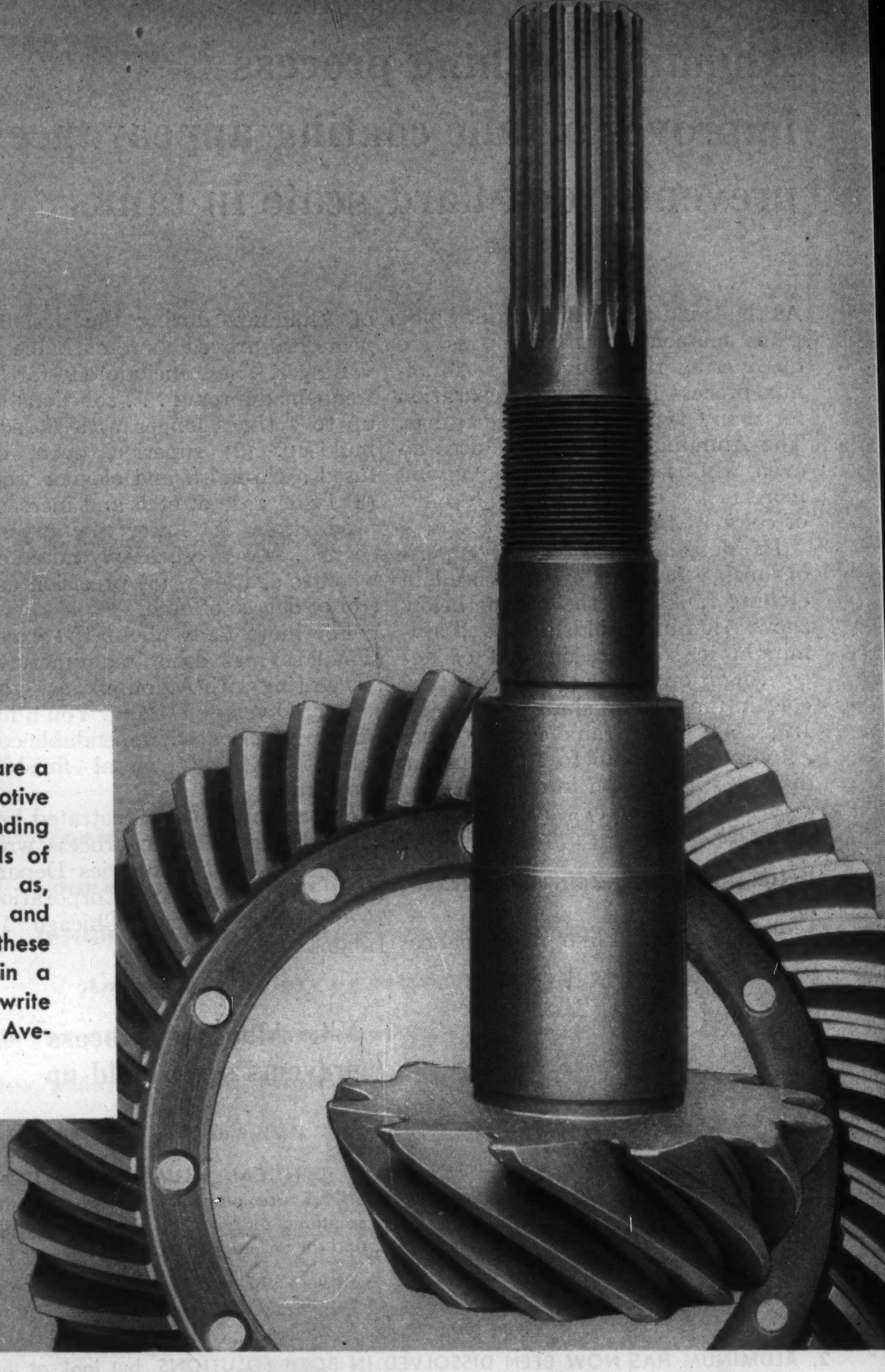
Fatigue life

Commonly published static strength properties of reinforced polyester laminates are sufficient to establish that, in thick enough sections, strength is more than sufficient to meet the immediate requirements in car bodies. Although these static properties, such as stiffness and tensile, flex-

For more information, Circle No. 486 ➤

"'S BETTER IF IT CONTAINS MOLY"

Moly carburizing steels with 0.5% Mo are a natural for components like this automotive ring-gear and pinion. They have outstanding properties that suit them to the demands of gearing and similar applications, such as, superior case hardness, low distortion and good machinability. Many features of these new carburizing steels are discussed in a recent technical article. For a reprint, write Climax Molybdenum Company, 500 Fifth Avenue, New York 36, N. Y., Dept. 6.



Molybdenum Carburizing Steels

MOLYBDENUM OFFERS THE ECONOMICAL KEY TO PERFORMANCE

Over the years, molybdenum carburizing steels have proved their merits in scores of applications and at every level of production.

Design engineers know moly steels for their uniform hardenability, toughness and wear resistance.

Production men know that moly steels are easy to heat treat, easy to machine.

Management knows that moly steels mean economy in fabrication, high performance in a wide range of end products.

Standard molybdenum carburizing steels are widely available. Higher moly analyses may be ordered in heat lots from a number of leading suppliers.

CLIMAX MOLYBDENUM

CLIMAX MOLYBDENUM

Use the Moly Key to better carburizing steels

- High case hardness
- Wide choice of hardenability
- Easy to heat treat
- Low distortion
- Good machinability
- Good wear

ADVERTISEMENT

Aluminux etching process improves anodic coating appearance, prevents rock-hard scale in tanks

As the trend to aluminum anodizing gains momentum, many firms are discovering that Diversey's Aluminux process is an ideal preparation for many types of anodic coatings. The Aluminux process produces an even, diffused, satin-finish, giving more lustre and greater uniformity of color to the anodized product.

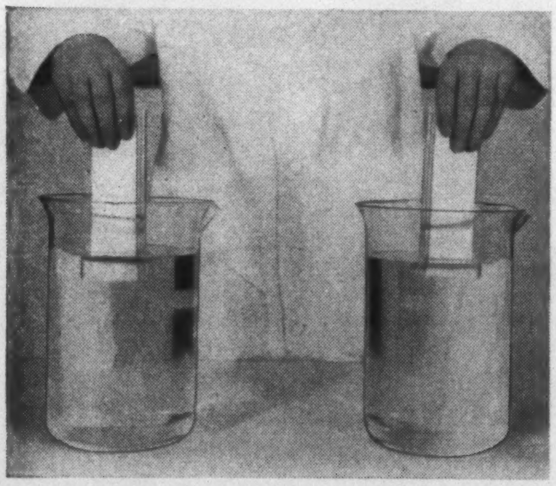
In addition to delivering a superior finish, Aluminux prevents scale in etching tanks. As the photos below show, Aluminux holds dissolved aluminum in solution, instead of depositing it on tank walls and heating coils in the form of sludge and scale. In a 1500 gallon tank, for instance, Aluminux holds up to 1,000 lbs. of dissolved aluminum in solution . . . *a potential one ton of scale that would otherwise have to be chipped off!*

Better, more easily-controlled etch at lower cost.

The production-line performance of Aluminux during the past few years has proved its remarkable advantages. These include: (1) far less frequent dumping . . . solutions last up to 4 times longer with no scale build-up, (2) superior, even, diffused satin-finish and cleaner work, (3) faster rate of etch and increased production, (4) lower maintenance costs . . . tanks are simply hosed out when re-charging, (5) precision control of degree of etch.

For more facts about the exceptional savings other manufacturers are getting with Aluminux, ask your nearby Diversey D-Man. You'll find him an experienced, dependable consultant on your metal finishing problems.

For an interesting illustrated brochure on the Aluminux process, write today to Metal Industries Department, The Diversey Corporation, 1820 Roscoe Street, Chicago 13, Illinois.



Why Aluminux process prevents scale build-up

1. IDENTICAL ALUMINUM EXTRUSIONS are placed in equal-strength solutions of Diversey Aluminux (left) and an ordinary etchant (right).

2. ALUMINUM HAS NOW BEEN DISSOLVED IN BOTH SOLUTIONS, but look at the difference! In the Aluminux solution at left, the dissolved aluminum has been held in solution with no trace of precipitate. But, in the ordinary etchant at right, the solution is cloudy with a heavy precipitate. This precipitate is aluminum oxide, the deposit that builds up as rock-hard scale inside your etching tanks.

For more information, turn to Reader Service Card, Circle No. 508

CONTENTS NOTED

ural and impact strengths, are not critical as such, they are probably the primary factors influencing fatigue life. They should therefore be kept as high as is consistent with other requirements.

According to Coffin, though much has been said about fatigue, no one has been able to relate it to a service requirement in an automobile. However, since 1) reinforced plastics *will* fail in fatigue, and 2) to the author's knowledge no service fatigue failure has been reported, Coffin concludes that the 20% endurance limit factor currently being used is adequate for design.

Compromise on impact

As is the case with most materials, greater stiffness in reinforced plastics is obtained at the sacrifice of impact strength, and vice versa. In order to attain the best balance of these and other properties, compromises must be made.

The author feels that his company has almost reached the point of optimum balance in mechanical properties, i.e., a point where performance commensurate with requirements is obtained in all respects. Moving very far in either direction, either toward materials with greater stiffness but lower impact strength, or toward materials with lower stiffness but greater impact strength, is likely to result in inferior service durability. Automobile body development experts have commented that sports cars completely equipped with reinforced plastics body panels and structural members are about equivalent to average steel body convertible coupes

Commercial Electroplates

Coming in July

A practical discussion of the different types of electroplates that are commercially available. The 16-page M&M Manual No. 128 also discusses the various factors that must be considered in selecting a plated finish.

THAT one is no good!

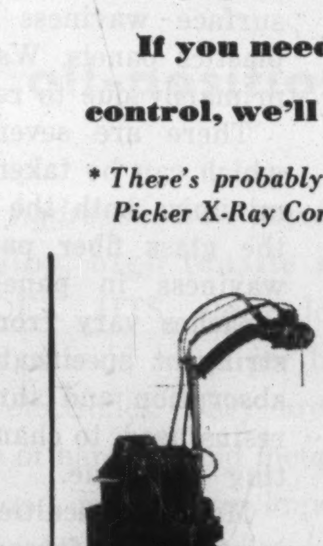
Wouldn't you like to be *that* sure about duds in your own production? Nondestructive radiography (either x-ray or gamma ray) could do it for you maybe.

***Anything* you buy or sell which needs "seeing into" is fair game for this versatile inspection method . . . weldments, castings, assemblies, plastics, wood, metal . . . right across the board from paper-thin stuff to foot-thick steel.**

If you need to spot hidden defects to keep a firm finger on quality control, we'll be glad to tell you what radiography can do for you.*

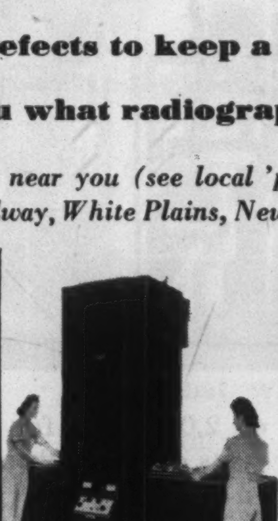
** There's probably a Picker District office near you (see local 'phone book). Or write Picker X-Ray Corporation, 25 South Broadway, White Plains, New York.*

5 to 50 KV
Small as a filing cabinet, yet it will x-ray anything up to ¼" thick aluminum. Self-contained, completely rayproof.

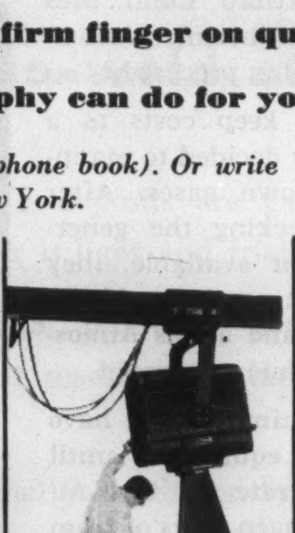


150 KV
Penetrates up to 1" steel and 5½" aluminum (more with screens). Stationary or mobile for "on-the-spot" x-raying.

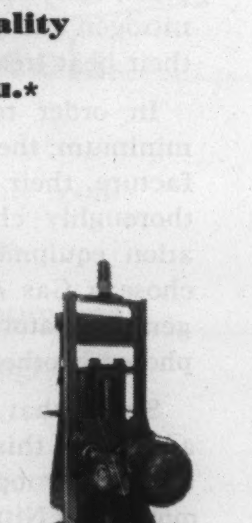
250 KV ***portable***
Rugged, lightweight 250 KV tubehead with separate remote power chassis. Will enter openings as small as 15" square.



RADIOGRAPHIC CABINETS
Rayproof enclosures obviate need for lead-lined rooms. Available with or without feeder tables.



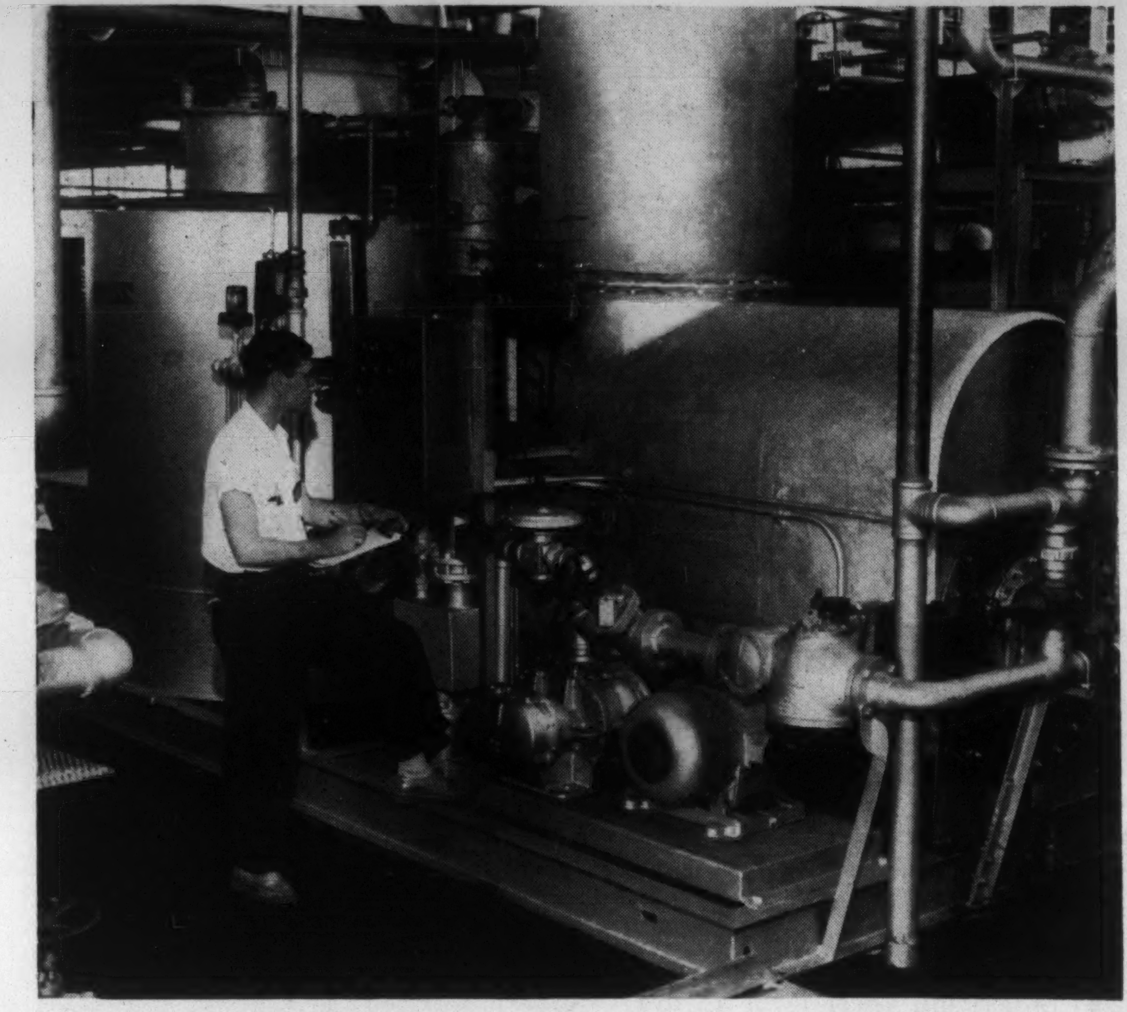
260 KV ***crane or dolly***
For heavy-duty inspection (up to 3" steel). Operating down to 60 KV, will x-ray a wide range of other materials.

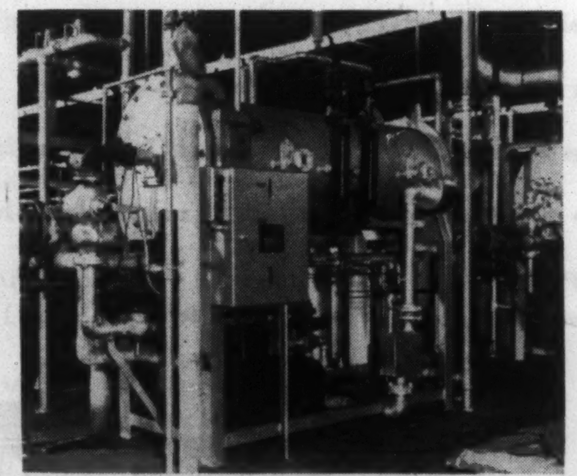


GAMMA ***Sources, equipment, containers.***
Panoramic, circumferential, and directional projectors using cesium, iridium or cobalt isotopes.

one source for everything in Picker x-ray **radiography and fluoroscopy**

For more information, turn to Reader Service Card, Circle No. 465





8 GAS ATMOSPHERES' GENERATORS USED BY PRATT and WHITNEY AIRCRAFT IN HEAT TREATING AIRPLANE PARTS

To stress relieve aircraft engine components of both high and low carbon, Pratt and Whitney Aircraft, East Hartford, Conn. uses nitrogen and exothermic gases in their heat treating processes.

In order to keep costs to a minimum, they decided to manufacture their own gases. After thoroughly checking the generation equipment available, they chose a Gas Atmospheres Nitrogen generator and a Gas Atmospheres exothermic generator.

Since that time, they have added to this equipment until today they operate six Gas Atmospheres Nitrogen units of from 3,000 to 6,000 cfh, for heat treating parts of medium high carbon, stainless and alloy steels, and two exothermic generators of 2,000 cfh, for heat treating parts of low carbon steel.

If you use atmospheres in your work, why not poin the ever-increasing list of nationally known manufacturers who agree it pays to make your own gas with Gas Atmospheres equipment.

9761

gas Atmospheres, inc
equipment for producing industrial gases
20011 WEST LAKE ROAD CLEVELAND 16, OHIO

For more information, turn to Reader Service Card, Circle No. 456

CONTENTS NOTED

with respect to shake, cowl movement, and torsional and beaming stiffness.

Appearance

A pleasing surface appearance is a prime requisite for an automobile body material. Since plastics resist exposure to salt spray and humidity better than metals, it might be natural to assume that they would have outstanding weathering characteristics. Actually, the reinforced plastics compositions used are adversely affected by exposure to the elements to a disconcerting degree.

One of the main effects of outdoor exposure is the appearance of the glass fiber pattern. The surface roughness of a laminate is caused by shrinkage of the resin. When such a surface is painted, the resin "valleys" take a heavier coat than the glass fiber ridges. During exposure, the paint film absorbs water and swells in proportion to its thickness, and valleys in the resulting rough surface reflect the shape of the reinforcement under the plastics' surface.

A more gross but possibly less objectionable appearance defect is surface waviness in reinforced plastics panels. Waviness, too, is primarily due to resin shrinkage.

There are several approaches which can be taken to correct or minimize both the appearance of the glass fiber pattern and the waviness in panels. These approaches vary from maintaining stringent specifications on water absorption and shrinkage of the resins used, to changes in laminating technique.

Major difficulties in bonded joints of reinforced plastics have been encountered because of deficiencies in fit-up, bonding practices and joint design. Coffin reports that his company, after extensive experimentation, has alleviated most of the difficulties by using low shrinkage adhesives, maintaining close control over shop practices in fit-up and bonding, and developing new and improved joint designs.

(Books on p 238)

another
NEW
product

MUREX® SPEEDEX HTS

TYPE E-7016

For all-position welding, of hard-to-weld steels

Low hydrogen–iron powder electrodes for low alloy, high tensile steels, MUREX SPEEDEX HTS electrodes deposit more pounds of weld metal per hour than conventional electrodes. They are preferred for a variety of hard-to-weld metals, where welding speed and strength are important and underbead cracking must be minimized or eliminated.

- SPEEDEX HTS gives a quiet, steady arc with good penetration.
- SPEEDEX HTS deposits are easily controlled . . . slag is light and friable.
- SPEEDEX HTS produces porosity-free welds that will readily pass radiographic inspection.

For further information on this or the complete line of Murex electrodes, machines and accessories, write or phone—there's an office near you.

WELDING SUPPLIES
RADIOGRAPHIC EQUIPMENT
PLATING MATERIALS
ORGANIC COATINGS
CERAMIC MATERIALS
TIN & TIN CHEMICALS
METALS & ALLOYS
HEAVY MELTING SCRAP

METAL & THERMIT
CORPORATION
GENERAL OFFICES: RAHWAY, N. J.

• For more information, turn to Reader Service Card, Circle No. 470

NEW!

LOW-COST MIRACLE FABRIC

FELTERS

ALLFAB

Unique, all-purpose non-woven fabric you can put to profitable use

Felters has combined a variety of fibers — wool, rayon, cotton, dynel, nylon and dacron — with a resin (thermoplastic) binder. Result: a felt-like fabric with a tremendous range of fiber combinations — using different diameters, lengths and gravities.

The thermoplastic binder has two big advantages: (1) AllFab will hold any embossed pattern, actually gives dimension to a design; and (2) it is possible to electronic "stitch" or heat seal, eliminating sewing. These features open a new realm of uses as low-cost filler and backing for plastics and upholstery, and for creating new packages and box designs.

Better yet, you name it! Felters will be glad to furnish samples and technical advice to help you save money with this low-cost AllFab.

One of the NEW family of felts . . .

MiraFelt®	MX-101
Dynel-Mat	AllFab
Unisorb®	Cut Felt Parts

Another Fabric First in . . .

FELT by FELTERS

Manufacturers of Felt and Felt Products

SEND for Free Sample and descriptive Bulletin.

FE6-13

The Felters Co.
220 South St., Boston 11, Mass.

Name.................................Title....................
Company...
Address...
City..............................Zone....State.................

For more information, turn to Reader Service Card, Circle No. 569

CONTENTS NOTED

BOOKS

Aluminium Taschenbuch. *Johannes Reiprich and Wilhelm v. Zwehl. Aluminium-Verlag G.m.b.H., Dusseldorf, West Germany. 1955. 6 by 9 in. 965 pp. Price $4.00.*

An enlarged edition in German of the well known reference book on aluminum and its alloys. It is issued by Aluminium-Zentrale, the central information service of the German aluminum industry.

Such subjects as working, heat treatment, fabrication and surface treatment are covered thoroughly. Alloys are listed with the standard German specification and with their nearest equivalents in other countries. Tables show physical and mechanical properties of all such alloys in the various forms in which they are usually supplied. A convenient table shows the corrosion resistance of pure and alloyed aluminum. There are also many tables of sizes and weights, 400 illustrations and extensive references. The relevant DIN specifications are listed in an index.

Theory and Practice of Lubrication for Engineers. *Dudley D. Fuller. John Wiley & Sons, Inc., New York 16, N. Y. Cloth, 6 by 9¼ in. 432 pp. Price $10.50.*

After presenting the theory of lubrication the author applies these principles to a wide range of lubrication problems. Many bearing designs are given, including among others, those for machine tools, turbines, generators, large motors, rolling mills, bar mills and centrifuges. Direct references are made to examples of recent research, and the techniques used and results achieved are discussed.

The chapter on bearing materials covers tin- and lead-base babbitts, bronzes, copper, lead, cadmium-base alloys, aluminum alloys, silver, porous metal, cast iron, glass, plastics, rubber and graphite.

Government - Industry Cooperation in Standardization. *American Standards Assn., New York 17, N. Y. 1955. Paper, 8½ by 11 in. 94 pp. Price $3.00.*

This volume contains the 30 addresses made by government, industrial leaders and military officials at the Sixth National Conference on Standards, held in Washington, D. C., October 1955. The conference, sponsored by the American Standards Assn. and the National Bureau of Standards, was the first of its kind ever held jointly by industry and a government agency.

Subjects discussed included the legal implications of standardiza-

Never before on a Power Plane...
a motor that spins at
25,000 RPM!

PORTER-CABLE
126

CASE HISTORIES FROM
MT. VERNON FILES

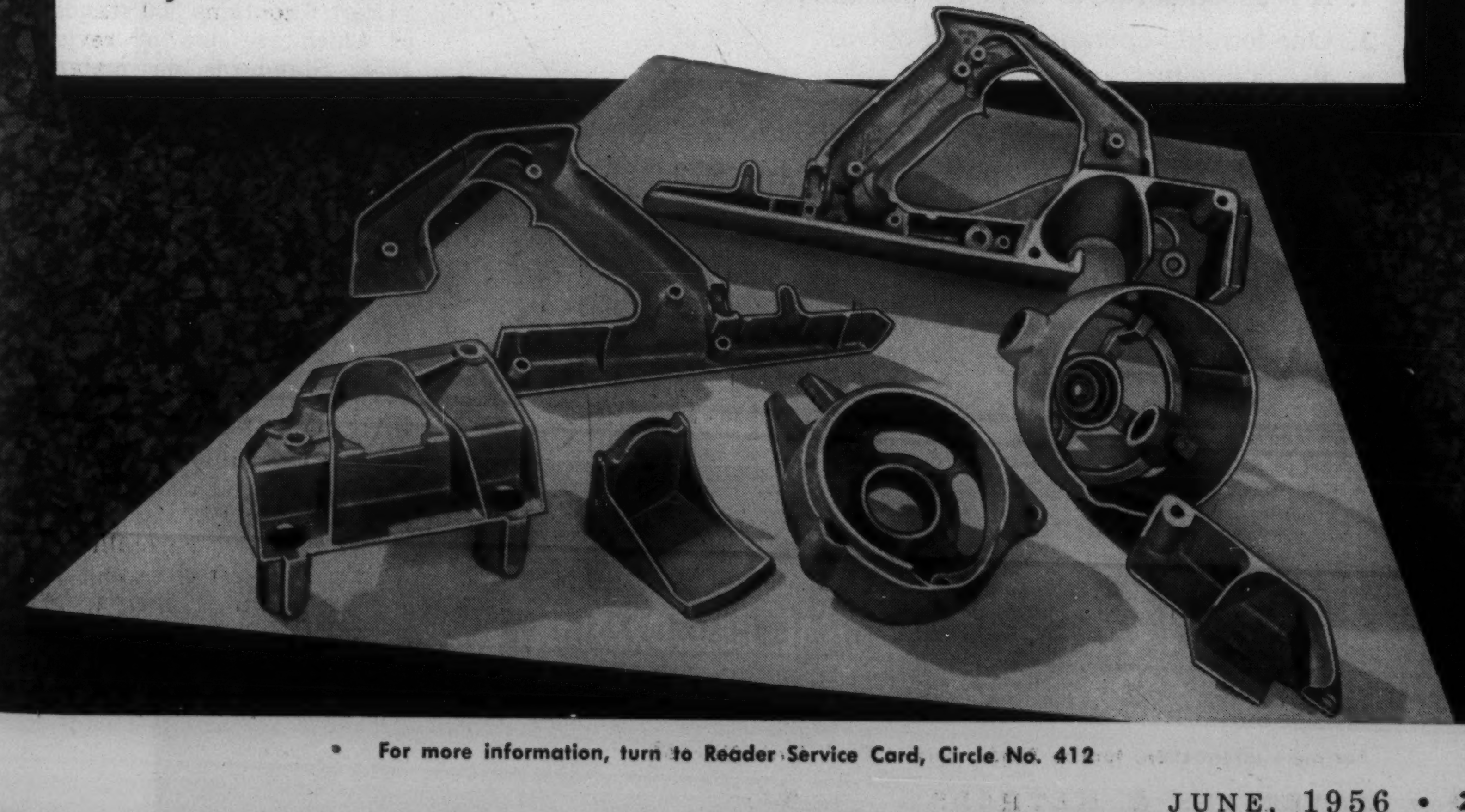
No power plane before this Porta-Plane has ever used such a high speed motor. And when any manufacturer is out to break all precedents, and still sell his product at a low price, he needs every bit of designing and production skill he can find—anywhere.

This manufacturer found these in generous abundance at Mt. Vernon. The 8 principal parts of the frame of the Porta-Plane were designed to obtain the special advantages of die casting: thin wall sections of great strength and rigidity, negligible machining, smooth finish, high speed production, low cost.

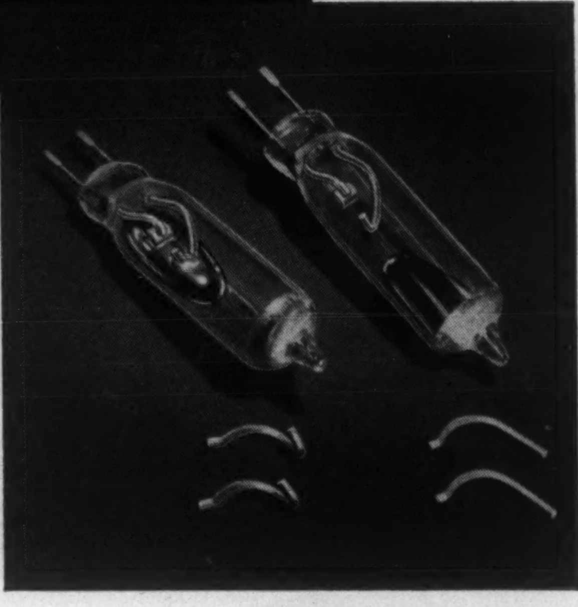
This important advantage—low cost—stems directly from the way we are organized here at Mt. Vernon. From die cast to finished casting, Mt. Vernon has both the complete die casting service and the facilities it takes to produce parts like these at minimum cost in any quantity. We have 162,000 square feet of the most modern equipment for making dies and for die casting aluminum and zinc. Mt. Vernon service comprises completely coordinated designing, die-making, casting, and machining, all under one roof.

It will pay you to bring your production specifications to us. We may show you, as we did Porter-Cable, the way to important cost reductions and improved products.

MT. VERNON
DIE CASTING CORP.
STAMFORD, CONNECTICUT



• For more information, turn to Reader Service Card, Circle No. 412



THE LITTLE HOOK THAT SAVED $20,000.00!

The Problem:

To produce molybdenum electrodes for use in mercury switches having (a) extremely close tolerances so that switch performance would be as uniform as possible and (b) incorporating a 45° angle hook in the design to insure a fast and clean make and break and to prevent arcing.

The case history told at the left is but one of hundreds of instances where Fansteel experience and facilities have saved substantial sums for users of molybdenum and other refractory metals. Perhaps you are using one or more of these metals now; or perhaps you could use them to advantage. In either case, you'll find it good policy to "Check with Fansteel!"

The Difficulty:

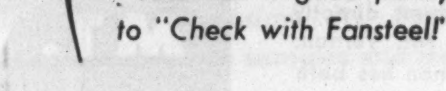
Working with partially fabricated parts furnished by Fansteel, the switch manufacturer completed the forming in his own plant. Despite careful handling, hooks developed cracks or splits as well as flat spots at the bottom.

The Solution:

Fansteel designed and built a four slide roll die and fabricated from continuous molybdenum wire. The results:

1. A production rate of 99 pieces per minute.
2. One forming operation instead of two.
3. Fewer handling procedures.
4. Loss from scrapped parts practically eliminated.
5. A SAVINGS OF $10.00 per thousand electrodes—$20,000.00 per year!

The true story reported here is typical of the news and technical comment contained in our publication, FANSTEEL METALLURGY. We'll be glad to place you on our mailing list; all we need is your name and address. No cost or obligation, naturally.



K561A

FANSTEEL METALLURGICAL CORPORATION
NORTH CHICAGO, ILLINOIS, U. S. A.

For more information, turn to Reader Service Card, Circle No. 556

CONTENTS NOTED

BOOKS

tion; government-industry standardization at the Army, Navy and Air Force level; the relationship of industry standards and specifications to those of government; and government-industry cooperation in international standardization.

Proceedings of the Standards Engineers Society's 4th Annual National Meeting. *Standards Engineers Society, Camden, N. J. 1956. Paper, 8½ by 11 in. 80 pp. Price $3.00.*

These 24 papers were presented at the Annual Meeting of the SES last fall. They include a panel discussion of standards programs operated by such companies as the Scintilla Div. of Bendix Aviation, IBM, General Precision and Ansco; national strength in relation to standardization; the case for voluntary standards; and a panel discussion of the American standard for preferred thicknesses of thin flat metals.

1955 Book of ASTM Standards. *American Society for Testing Materials, Philadelphia, Pa. 1955. Part 2—Non-Ferrous Metals. Cloth, 6 by 9 in. 1516 pp. Price $11.00. Part 6—Plastics, Electrical Insulation, Rubber, Electronics Materials. Cloth, 6 by 9 in. 1776 pp. Price $13.00. Part 7—Textiles, Soap, Water, Paper, Adhesives, and Shipping Containers. Cloth 6 by 9 in. 1692 pp. Price $11.00. Price $84.00 for complete set, seven parts.*

Part 2 covers coppers, lead, aluminum and magnesium, metal powders, and widely used test procedures. Of the 270 standards, 156 are new or have been revised since 1952.

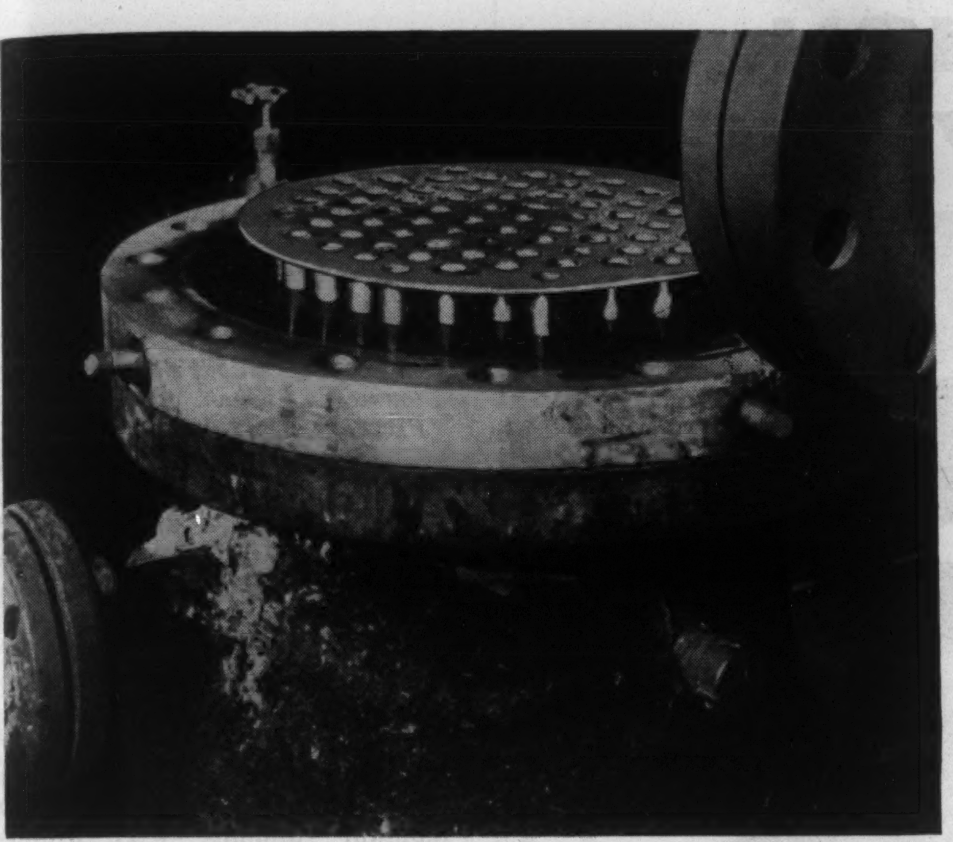
Part 6 contains 300 standards, 148 of which are new or revised since 1952. Standards on materials for electron tubes, formerly found in Part 2, have been added to this part.

Part 7 contains 354 standards, 166 of which are new or have been added since 1952.

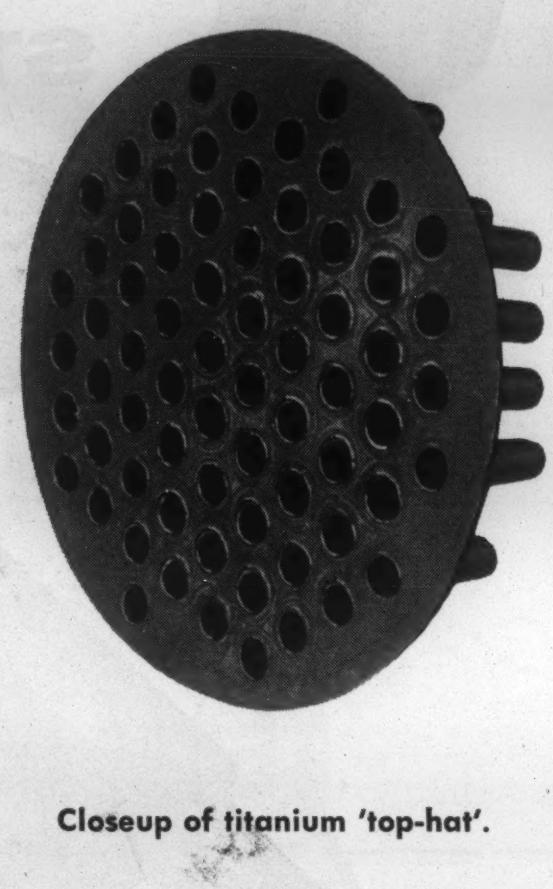
Technical Proceedings of the 42nd Annual Convention. *American Electroplaters' Society, Newark, N. J. 1955. Cloth, 8¼ by 11½ in. 255 pp. Price $10.00.*

The convention was held in Cleveland, Ohio, in July 1955. Subjects discussed include the plating of yellow brass, zinc, cadmium and lead-tin-antimony; plating on beryllium copper and powder-metallurgy bronze parts; and electroless nickel plating of nonconductors. The papers are illustrated with graphs, tables and photographs.

(Reports on p 242)



'Top-hat' of REM-CRU titanium in service on condenser at E. I. duPont de Nemours, Inc.



Closeup of titanium 'top-hat'.

how TITANIUM 'top-hat' thwarts corrosion damage to DuPont condenser...

Problem: DuPont chemical engineers faced a particularly vexing problem in the frequent failure of a stainless steel condenser handling 60% nitric acid at 480F and 300 psi. Every five months or so, it became so badly corroded that replacement was necessary. Unit costs and downtime were serious.

Solution: Since failures always occurred at the condenser top, DuPont engineers decided to try protecting that area with a 'top-hat' insert of REM-CRU titanium. It consists of a titanium disc twelve inches in diameter, to which a cluster of 70 thin wall titanium tubes is welded. Fitting snugly into the top of the stainless steel condenser, the titanium protects the area where trouble started. *And it stopped failures completely.* The 'top-hatted' condenser has been in service for more than 16 months and still shows no sign of corrosion beyond a slight discoloration.

Dollars and Cents Facts About Titanium: It's true that titanium sheet and tubing cost more than stainless steel. But titanium's light weight (40% lighter than steel), means you must buy fewer pounds of *metal* for a given area. Furthermore, the cost of the metal is only a fraction of the cost of the finished assembly. Substituting titanium for stainless, therefore, increases the cost of a finished reactor, autoclave, valve or other piece of chemical equipment by only two or three times. Where titanium extends the service life of parts by such a factor, or eliminates costly maintenance and downtime, it's the obvious choice over cheaper but less corrosion-resistant metals.

At REM-CRU you can now get *prompt* delivery of this versatile metal in a wide variety of sizes, shapes and grades — including new high-strength, weldable alloys. REM-CRU engineers will be glad to help with selection, application or fabrication problems.

To keep abreast of the latest developments on this vital metal, write to Dept. M-6 for the Rem-Cru Review — a free periodical presenting the latest technical data on titanium alloys.

REM-CRU TITANIUM

REM-CRU TITANIUM, INC., MIDLAND, PENNSYLVANIA

For more information, turn to Reader Service Card, Circle No. 373

PRODUCT DESIGN WITH DUREZ PHENOLICS

for HIGH STYLING

. . . or

HEAVY DUTY

DUREZ

offers industrial designers almost unlimited scope

● One manufacturer wanted fresh new contours, interesting color, permanence of finish, strength, heat-resistance . . . and economy. The other wanted intricate shapes with holes, grooves, and slots molded-in, self-insulation, rigidity, close tolerances . . . and economy.

Requirements of both are being met in all respects—including production economy—with materials selected from the six classes that constitute the Durez family of versatile molding materials.

Being phenolics, these thermosetting plastics are true engineering materials with an unsurpassed range of industrial applications. You can use their mechanical, electrical, thermal, and chemical properties in creating products that look better, serve better, sell better.

Call on your molder—or our Technical Field Service—for help in solving your problems.

DUREZ®

Phenolic Plastics that fit the job

DUREZ PLASTICS DIVISION
HOOKER ELECTROCHEMICAL COMPANY
1406 Walck Road, North Tonawanda, N. Y.

HOOKER. CHEMICALS PLASTICS

For more information, turn to Reader Service Card, Circle No. 514

CONTENTS NOTED

REPORTS

Magnesium coatings PROTECTIVE COATINGS FOR MAGNESIUM. *T. Kirk Hay, Gerald F. Bechtle, Garmond G. Schurr and Maurice Van Loo, Sherwin-Williams Co. Oct 1954. 216 pp, photos, tables. Available from Office of Technical Services, Dept. of Commerce, Wash. 25, D. C. $5.50. (PB 111886)*

Recommended finishing systems use a vinyl toluene-ether ester vehicle in both primer and topcoat. Primers contain 35% by volume of zinc chromate and silicon dioxide pigments. Solvent resistance of these coatings has been variable; the two types evaluated softened badly but showed fair recovery upon solvent evaporation. Polysulfide and furan resin vehicles and a pigment prepared from calcium sulfide and ammonium vanadate were promising enough to warrant further study.

Vinyl finishes RESINS FOR VINYL FINISHES. Part II: Atmospheric Resistance. *S. B. Crecelius, Naval Research Laboratory. Dec 1955. 17 pp, graph, tables. Available from Office of Technical Services, Dept. of Commerce, Wash. 25, D. C. 50 cents. (PB 111824)*

Purpose of study was to establish the type of alkyd resin that could best be used in combination with vinyl resin (VAGH) in topside coatings for Navy ships. Tropical exposure, salt spray, salt spray cabinet, weatherometer and roof exposure tests were made on paints containing alkyd resins made from varying proportions of phthalic anhydride and different fatty acids and polyhydric alcohols. Epon ester and straight Epon resins were also studied. For Part I, see PB 111369.

SAE 4340 steel EFFECT OF STRAIN RATE ON THE TENSILE PROPERTIES OF SAE 4340 STEEL. *R. F. Klinger, Wright Air Development Center. Feb 1955. 30 pp. Available from Office of Technical Services, Dept. of Commerce, Wash. 25, D. C. $1.00. (PB 111948)*

Effects of tensile strain rates from 0.00002 to 20 in./in./sec were determined at room temperature on SAE 4340 steel ranging from the annealed condition to a nominal ultimate strength of 220,000 psi. Results show that strength properties are greater at high strain rates than at low strain rates, but that this strain rate effect is less as the strength level of the steel is increased. The 220,000 psi steel shows no change or a slight loss in strength at the higher strain rates. Elongation was not affected

Look into REVERE Phosphor Bronze –it pays RAVENNA to use it!

This Moen Single Handle Mixing Faucet contains an anchor disc and an anchor washer, both stamped out of Revere Phosphor Bronze Strip. These are small parts, but in a fine product such as this faucet, high quality metals must be used throughout. Here is a condensation of the manufacturer's experience with the phosphor bronze:

Anchor Disc: • Standard punching speed maintained. • No pre-straightening off the arbor for the automatic punching process. • No excessive die wear. • Corners are sharp and clean; no de-burring needed. • Natural mill finish is better than they could achieve by tumbling or burnishing. • High tin content means no lubrication is required; they call it "silent brass."

Anchor Washer: • Have not had a single surface failure. • Dry tumble to de-burr. • Good fatigue characteristics and no obvious signs of corrosion.

Revere offers several types of phosphor bronze, each with slightly different characteristics. In addition to this alloy, Revere also supplies Ravenna with round and octagonal leaded brass tube and free-cutting brass rod, for use in various parts of the valve. We will be glad to collaborate with you on selection of just the right forms of the correct alloys for your products, present or projected. See the nearest Revere Sales Office.

Moen Single Handle Mixing Faucet, made by Moen Valve Co., Division of Ravenna Metal Products Corp., 6518 Ravenna Ave., Seattle 15, Wash.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801
230 Park Avenue, New York 17, N. Y.

• • •

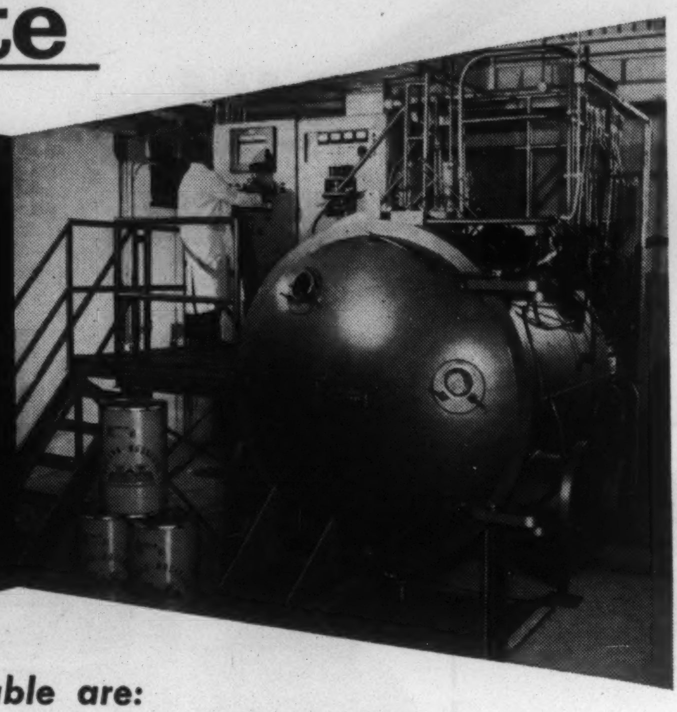
Mills: Baltimore, Md.; Brooklyn, N. Y.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif., New Bedford, Mass., Newport, Ark.; Rome; N. Y. Sales Offices in Principal Cities, Distributors Everywhere.

"The Revere Four-Way Service" is a 16 mm. sound motion picture in color, educational and informative. If you haven't seen it, write nearest Revere Office.

For more information, turn to Reader Service Card, Circle No. 400

Now...Cannon-Muskegon offers
complete

VACUUM MELTING service and UltraMet alloys...



Now available are:

stainless, tool and die, magnetic steels—high-temperature, corrosion-resistant, expansion alloys—bearing steels—electrical and electronic alloys—special alloys

RIGHT NOW . . . Cannon-Muskegon provides you with a ready source of super-clean, superior strength alloys to meet complex metallurgical applications. Our completely equipped and expertly staffed vacuum melting facilities as well as chemical, physical and metallurgical laboratory can help you *find, test and produce* vacuum melted alloys for any application . . . in test or production quantities . . . with accurately predictable properties.

Ferrous, nickel and cobalt-base alloys are poured at pressures from 1 to 10 microns — resulting in extremely clean metals for smoother surfaces . . . greater tensile strength, ductility and wear life . . . and higher electrical and magnetic properties. Contact Cannon-Muskegon for facts.

Finest laboratory and production equipment is used in our vacuum-melting operation . . . available to you. Let our metallurgical specialists help you solve your alloy problem.

We offer industry

- *Materials for remelt* — under conventional air melting, inert gas, vacuum.
- *Casting development* — includes research and experimental facilities for investment, shell mold, dry sand, and permanent mold castings.
- *Ingots or cast billets* — for rolling, forging or extruding in individual weights up to 250 pounds.

ULTRA MET
VACUUM-MELTED ALLOYS
FOR INDUSTRY

For full particulars write for our New Bulletin on Vacuum-Melting and Air-Melting facilities, products and service.

CANNON-MUSKEGON
CORPORATION
2873 Lincoln Street Muskegon, Michigan
METALLURGICAL SPECIALISTS

For more information, turn to Reader Service Card, Circle No. 582

by the change in strain rate at any strength level tested.

New high strength steel MECHANICAL PROPERTIES OF A NEW HIGH-STRENGTH HIGH-TOUGHNESS GENERAL-PURPOSE ALLOY. *W. E. Dirkes, R. E. Bowman and E. L. Horne, Wright Air Development Center. Aug 1952. 28 pp. Available from Office of Technical Services, Dept. of Commerce, Wash. 25, D. C. 75 cents. (PB 111617)*

Mechanical properties of a chrome-nickel-molybdenum-vanadium general purpose medium-carbon alloy steel (modified SAE 4330 plus vanadium) made by Republic Steel Corp. Combination of high strength and toughness may make this steel suitable for aircraft applications.

Titanium interstitials EFFECTS OF CARBON, OXYGEN AND NITROGEN ON THE MECHANICAL PROPERTIES OF TITANIUM AND TITANIUM ALLOYS. *H. R. Ogden and R. I. Jaffee, Battelle Memorial Institute. Oct 1955. 102 pp, graphs, tables. Available from Office of Technical Services, Dept. of Commerce, Wash. 25, D. C. $2.75. (PB 111982)*

These interstitial elements strengthen titanium although the effect is lost at elevated temperatures. At room temperatures interstitials have little effect on tensile ductility but at subzero temperatures they promote embrittlement. They also have a deleterious effect on toughness, notch sensitivity, weld ductility, machinability and bend ductility. Strengthening effect of individual or combined interstitials can be expressed in terms of an oxygen equivalent. Bibliographies given.

Fatigue of N-155 DAMPING, ELASTICITY, AND FATIGUE PROPERTIES OF UNNOTCHED AND NOTCHED N-155 AT ROOM AND ELEVATED TEMPERATURES. *L. J. Demer and B. J. Lazan, Univ. of Minnesota. Feb 1953. 77 pp. photos, diags, graphs, tables. Available from Office of Technical Services, Dept. of Commerce, Wash. 25, D. C. $2. (PB 111618)*

Properties obtained for unnotched and notched specimens at room temperature, 1350 and 1500 F are compared on two bases: equal stress and equal stress ratio. Equations are developed for interpreting rotating cantilever beam data so that effective length of specimen fillets, specific damping energy and dynamic modulus of elasticity may be calculated. Continues study reported in PB 116824.

(More Reports on p. 246)

WOULD A TOUGHER STEEL CHANGE YOUR PLANS?

New Lukens "T-1" steel has three times the yield strength of carbon steel—cuts equipment weight, cuts costs!

■ Here's a new alloy steel with unusual resistance to abrasion, impact and atmospheric corrosion . . . that *stays* tough at temperature extremes. And where extra strength is required from plate steel, Lukens "T-1" steel makes possible substantial overall savings in material.

If you plan or purchase bridge parts, construction machinery or any general industrial equipment, check Lukens "T-1" steel now! Its rugged on-the-job performance can reduce maintenance expense and replacement costs—often provide longer service life!

The latest addition to a complete line of carbon, alloy and clad steels, this all-purpose material is obtainable from Lukens in the widest range of plate sizes available anywhere! Whether you want specific product information or the best ways to make the most of it, write to Manager, Marketing Service, 850 Lukens Building, Lukens Steel Company, Coatesville, Pennsylvania.

Whatever your plans—now's the time to change to . . .

LUKENS "T-1" STEEL LUKENS

THE NEWEST IN A COMPLETE LINE OF ALLOY STEELS
LUKENS STEEL COMPANY, COATESVILLE, PENNSYLVANIA

For more information, turn to Reader Service Card, Circle No. 364

STRETCH

your metal cleaning dollars with

PERM-A-CLOR

(trichlorethylene)

Your dollars will go a lot further if you buy a premium grade solvent. Detrex Perm-A-Clor is a premium grade trichlorethylene . . . available at the same price as ordinary solvent. Perm-A-Clor is mighty important to you because it:

1 *Assures less maintenance cost*
2 *Is easier to control*
3 *Is much easier to check*
4 *Eliminates blind spots in your degreasing operation*
5 *Is more highly stabilized, thus lasts longer*

You get all these benefits, plus expert service assistance, for the same price as ordinary solvent. The result is that with Perm-A-Clor your production costs are reduced because you use fewer gallons of solvent per month. Mail the coupon for complete information.

☐ Send me complete information on Detrex Perm-A-Clor

NAME____________________

COMPANY____________________

ADDRESS____________________

CITY__________ ZONE____ STATE________

DETREX CORPORATION DEPT. A-302
BOX 501, DETROIT 32, MICH.

DEGREASERS • DEGREASING SOLVENTS • WASHERS • ALKALI AND EMULSION CLEANERS • PHOSPHATE COATING PROCESSES

For more information, turn to Reader Service Card, Circle No. 453

CONTENTS NOTED

REPORTS

Strength of Stainless DEFORMATION STUDIES OF METALS AT ELEVATED TEMPERATURES. II. The Iron-Chromium-Nickel Ternary System. III. Effect of Structure and Composition on the Strength Properties of Stainless Steel. IV. Effect of Cold Work on the Strength Properties of Stainless Steels. *N. J. Grant, H. C. Chang, P. E. Price, F. C. Monkman and F. B. Cuff. Massachusetts Inst. of Technology. Jan 1955. 8 pp, tables. Available from Library of Congress, Photoduplication Service, Publications Board Project, Wash. 25, D. C. Film $1.80, stat $1.80. (PB 119213)*

Welded aluminum fatigue FATIGUE PROPERTIES OF TUNGSTEN-ARC BUTT-WELDED WROUGHT ALUMINUM ALLOYS. *Ture T. Oberg and Edward J. Ward, Wright Air Development Center. Oct 1951. 27 pp, photos, drawing, graphs, tables. Available from Office of Technical Services, Dept. of Commerce, Wash. 25, D. C. 75 cents. (PB 111616)*

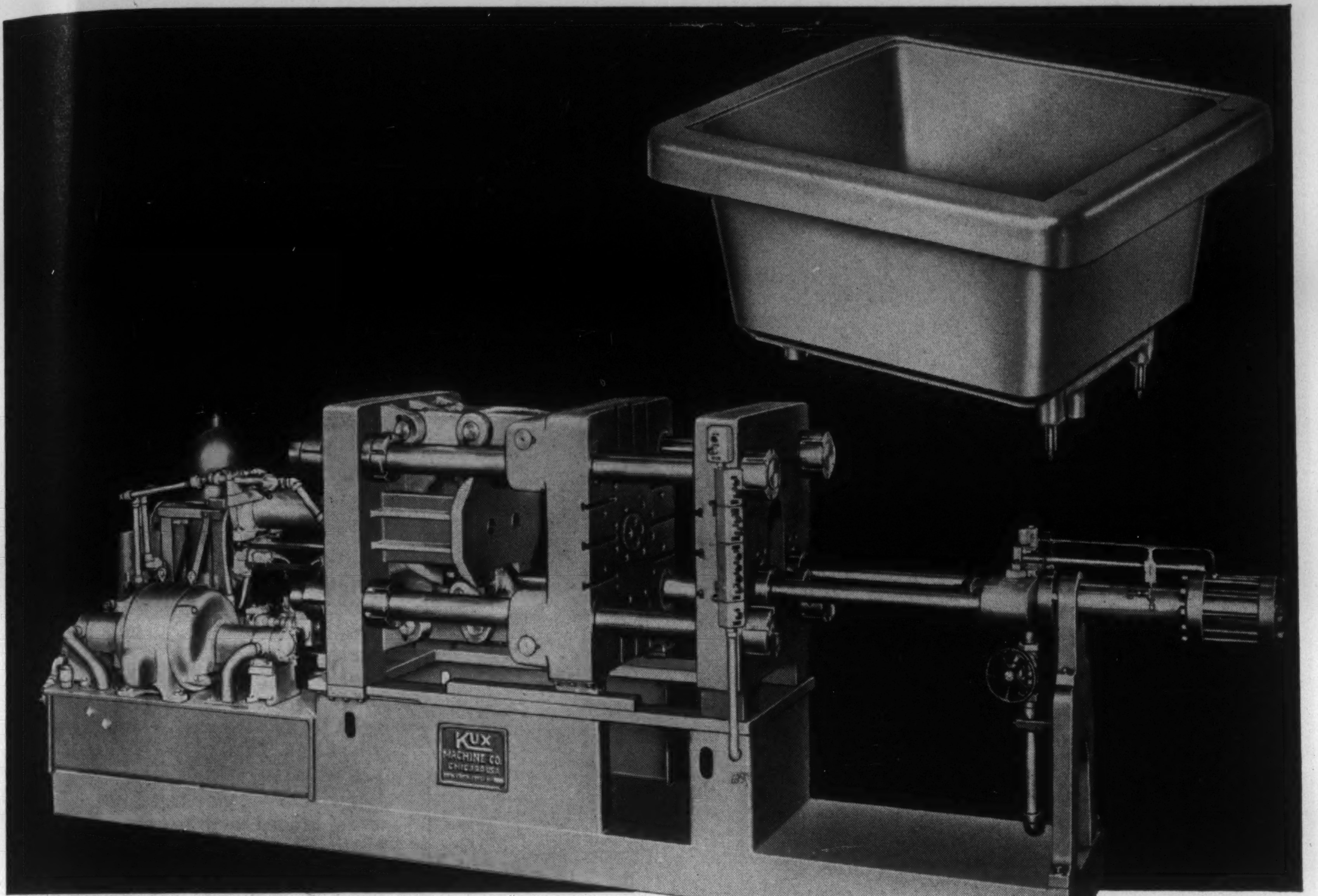
After determining fatigue characteristics by reverse bending and investigating effects of post-weld heat treating and of filler material, the authors conclude that the argon gas-shielded tungsten-arc welding process does not produce joints in 7075-T 2014-T alloys of satisfactory strength.

Chromium plating INDUSTRIAL APPLICATION OF CHROMIUM PLATING, A REVIEW OF LITERATURE. *M. Kolodny, National Research Council. Nov 1942. 81 tables. Available from Library of Congress, Photoduplication Service, Publications Board Project, Wash. 25, D. C. Film $4.80, enl pr $15.30. (PB 119511)*

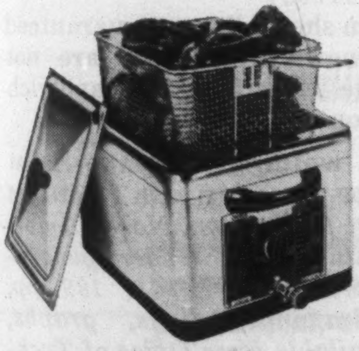
Titanium diffusion coatings ELECTRODEPOSITION OF TITANIUM. *Albert W. Schlechten, Martin E. Straumanis and C. Burroughs Gill, Univ. of Missouri. Nov 1954. 59 pp, photos, drawings, diags, graphs, tables. Available from Office of Technical Services, Dept. of Commerce, Wash. 25, D. C. $1.50. (PB 111798)*

Diffusion coatings of titanium on iron, mild steel, copper and other metals have good corrosion resistance. Process variables discussed. Also, data on corrosion of titanium in fused salts, resulting products and probable mechanism.

Titanium alloy properties ENGINEERING PROPERTIES OF COMMERCIAL TITANIUM ALLOYS. *M. W. Mote, Jr., and P. D. Frost. Battelle Memorial Inst. Sep 1955. 90 pp, graphs, tables. Available from Office of Technical*



to get ***hardware finish quality castings*** *with cast-in heating elements* **EASTERN METAL PRODUCTS** *chose...*



KUX DIE CASTING MACHINES

for the Alcamatic Cooker and Deep Fry

"The die-cast well is the heart of our ALCAMATIC Cooker and Deep Fry and naturally must be of top-quality construction," says Mr. Seymour Troy, executive vice-president of Eastern Metal Products Corp., Tuckahoe, N.Y.

"The use of KUX machines (3 in the Forth Smith, Ark., plant and 4 in our Tuckahoe factory), plus our own production processing, enables us to provide the finest aluminum well, making the product an excellent working unit as well as an attractive appliance.

"KUX machines make the difficult problem of cast-in Calrod heating elements easy," Mr. Troy says, "plus cutting our production costs considerably.

"The hardware finish quality castings provided by KUX machines eliminates many polishing and finishing operations and leaves the fry well easy for the housewife to clean."

For the manufacture of electrical appliances requiring dense hardware finish quality castings, KUX die casting machines are unexcelled. Write for our NEW illustrated catalog.

MODEL HP-37 ILLUSTRATED

Hydraulically operated die casting machine for production of aluminum castings.

KUX MACHINE CO. 6725 NORTH RIDGE AVENUE • CHICAGO 26, ILLINOIS

For more information, turn to Reader Service Card, Circle No. 517

Photo courtesy American Sterilizer Co., Erie, Pa.

"Just What the Doctor Ordered"

New Super-Soft Rubber Pads Developed for Surgical Table Headrest

This surgical patient's head is in firm but gentle hands. The tight grip of the surgical table headrest shown above is now cushioned by super-soft (20 durometer) solid rubber pads. These pads are almost as soft as sponge but can be decontaminated and sterilized far more easily. Being made of neoprene, they are unaffected by oils, acids or decontaminating and sterilizing solutions. Furthermore, repeated sterilizing in live steam does not cause excessive hardening.

The neoprene compound specially developed for this purpose is 10 to 15 durometer points softer than normal commercial limits. For that reason, special care and skill must be taken in mixing and molding.

The successful development of this special purpose rubber part typifies the complete engineering and laboratory—as well as manufacturing—service offered by Continental.

Why not let Continental engineers consult with you in the planning or blueprint stage? Their specialized skill might help you get better rubber parts for your requirements.

Engineering catalog.

In addition to custom-made parts, Continental offers an extensive line of standard grommets, bushings, bumpers, rings and extruded shapes. Hundreds of these standard parts are shown in Continental's No. 100 Engineering Catalog. Send for a copy today. This catalog also is shown in Sweet's File for Product Designers.

Another achievement in **RUBBER**

engineered by **CONTINENTAL**

CONTINENTAL RUBBER WORKS • 1985 LIBERTY ST. • ERIE 6 • PENNSYLVANIA

For more information, turn to Reader Service Card, Circle No. 506

CONTENTS NOTED

REPORTS

Services, Dept. of Commerce, Wash. 25, D. C. $2.25. (PB 111981)

General composition and designation of alloys that have been made in commercial size ingots (as of summer, 1955), properties of these commercial alloys in the annealed and heat treated conditions, and a review of data on the uniformity of alloys.

Tungsten - molybdenum brazing PHASE REPORT ON BRAZING TUNGSTEN TO MOLYBDENUM. *J. T. Niemann and R. P. Sopher, Battelle Memorial Inst. Nov 1955. 33 pp, photos, drawings, tables. Available from Library of Congress, Photoduplication Service, Publications Board Project, Wash. 25, D. C. Film $3, stat $6.30. (PB 119440)*

Two curved simulated nozzle blocks were brazed and pressure tested to evaluate strength of joints between tungsten and molybdenum. Both copper and 72 silver-28% copper alloys were used as filler materials.

Titanium for airframes SELECTION OF MATERIALS FOR HIGH-TEMPERATURE APPLICTIONS IN AIRFRAMES. *S. A. Gordon, Battelle Memorial Inst. Aug 1955. 38 pp, graphs. Available from Office of Technical Services, Dept. of Commerce, Wash. 25, D. C. $1. (PB 111980)*

Titanium sheet alloys at guaranteed yield strengths of 110 ksi are not competitive materials for sandwich construction.

Titanium welding SPOT AND SEAM WELDING OF TITANIUM AND TITANIUM ALLOYS. *D. E. Dawson, North American Aviation, Inc. Under government contract. Apr 1954. 189 pp, photos, drawings, diags, graphs, tables. Available from Office of Technical Services, Dept. of Commerce, Wash. 25, D. C. $4.75. (PB 111707)*

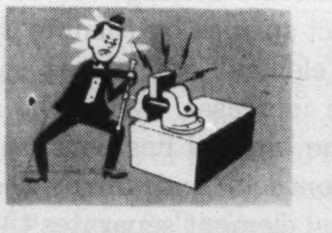
Final Report. Spot and seam welding process as may be readily applied to production grades of commercially pure titanium sheet, to the oxygen-nitrogen titanium-base alloy Ti-100A, and to the 8% magnesium titanium-base alloy. Simple welding equipment of the a.c. type is most suitable, and a wide range of settings may be used. Surface preparation treatments are necessary only on heavily oxidized material or where surface conditions vary. Spot and seam welds in commercially pure titanium and oxygen-nitrogen alloys have consistent, determinable and usable static and dynamic engineering properties at room and elevated temperatures.

A combination...for relaxation at Home

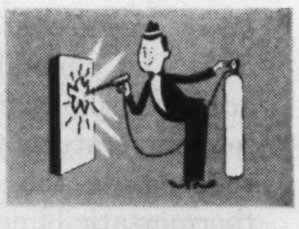
Laminated plastics . . . a combination of properties at work

It takes a combination of properties to satisfy many of your basic material requirements. Synthane laminated plastics provide a unique combination of mechanical, electrical and chemical properties plus ease of machining.

High-speed reversing clutch cone made of Synthane molded-macerated laminated plastic increases productivity of automatic screw machines. Synthane meets all the demands of high-speed clutch operation . . . *light weight, great strength* and *excellent heat resistance* for split-second reversing of a positive spindle drive operating as high as 3025 rpm and with operating temperature of cone going up to 250°F. This Synthane clutch cone provides smooth, positive clutch action, is long wearing, and is not distorted or deteriorated by the high heat.



COMPRESSIVE STRENGTH

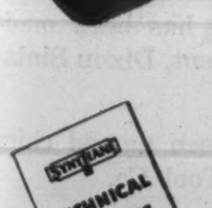


HEAT RESISTANCE

LIGHT WEIGHT

WEAR RESISTANCE

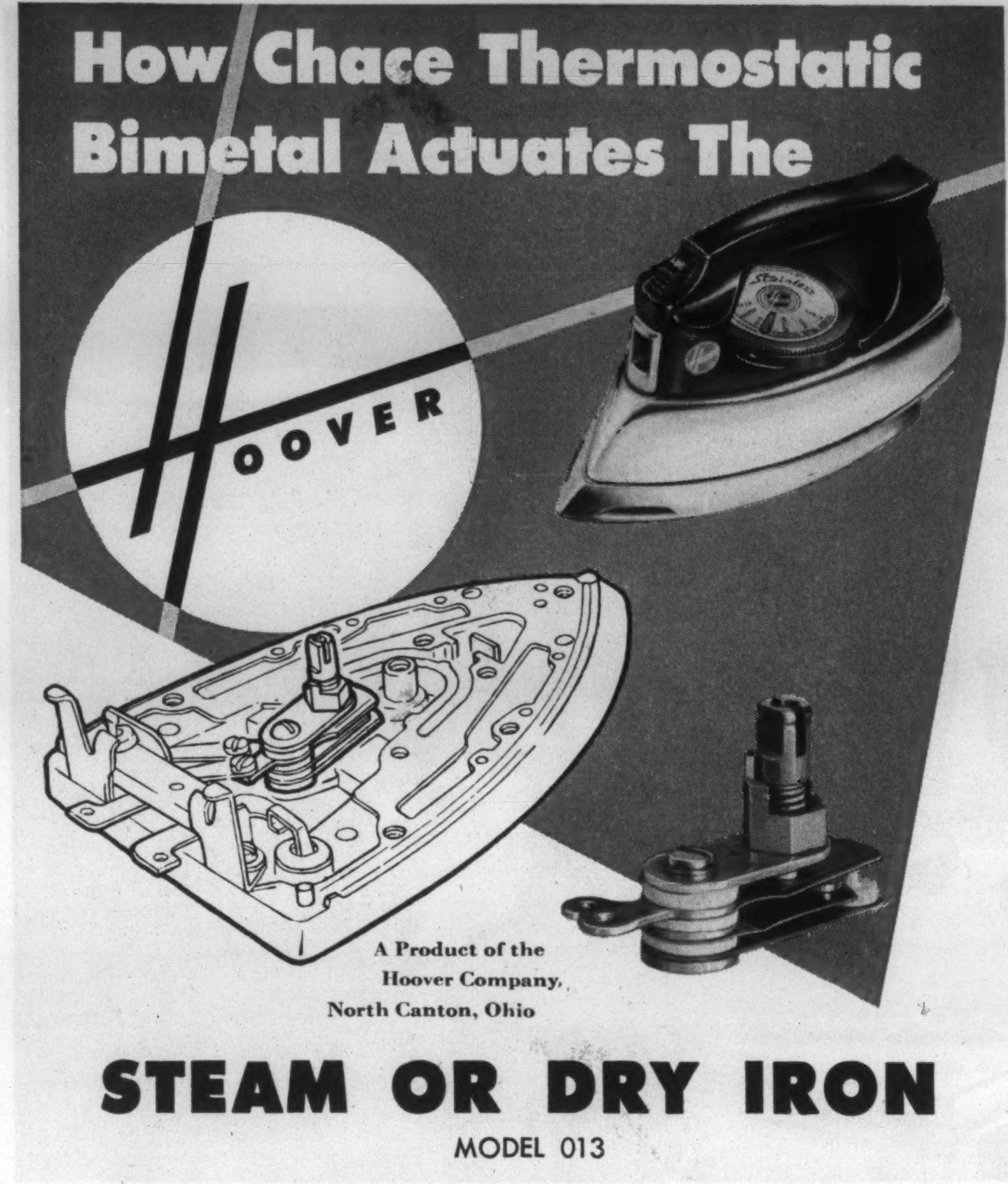
Property combinations! Synthane has them... in over 30 individual grades... sheets, rods, tubes, moldings and completely fabricated parts. Send for free illustrated catalog today.



SYNTHANE

SYNTHANE CORPORATION, 3 RIVER ROAD, OAKS, PA.

For more information, turn to Reader Service Card, Circle No. 452



How Chace Thermostatic Bimetal Actuates The

A Product of the
Hoover Company,
North Canton, Ohio

STEAM OR DRY IRON

MODEL 013

This new Hoover Model 013 Steam or Dry Iron offers a host of unique features such as a stainless steel sole plate, easy disassembly for descaling of flash chamber, cast-in tubular sheath type heating element and other evidences of progressive engineering. The dial settings for all fabrics, either steam or dry ironed, and the reliable Chace Thermostatic Bimetal element are features users may depend on for safe, fast, faultless ironing.

The various temperature settings are obtained by varying the stress on the contact springs by turning the Safety Set selection dial. The bimetal element deflects as the temperature of the adjacent sole plate increases. When the sole plate reaches the set temperature, the bimetal has bent in the amount necessary to separate the contacts and break the power circuit. The thermostatic bimetal element separates the contacts by pressing against the upper contact spring through a ceramic pin attached to the outer end of the element. As the sole plate cools, the bimetal straightens, permitting the contacts to close, thus completing the power circuit.

Chace Thermostatic Bimetal is available in 29 types, in strip, coil or completely fabricated and assembled elements made to your specification. Write for new 44-page booklet, "Successful Applications of Chace Thermostatic Bimetal," containing interesting uses of bimetal, formulas, calculations, etc.

IT BENDS WITH THE HEAT
W. M. CHACE CO.
Thermostatic Bimetal
1615 BEARD AVE., DETROIT 9, MICH.

For more information, turn to Reader Service Card, Circle No. 549

NEWS OF ENGINEERS COMPANIES SOCIETIES

Thomas L. Ward has been appointed manager of the ALCO Products, Inc., plant at Dunkirk, N. Y.

Thomas P. McGuinness has been made supervisor of engineering, chemical products, Barrett Div., Allied Chemical & Dye Corp.

Howard Shaeffer Avery, research metallurgist at the Metallurgical Lab. of the American Brake Shoe Co., received the Annual Award of the American Society for Metals' New York Chapter at the Chapter's regular meeting in April. The award was made in recognition of Mr. Avery's contributions to the technology of heat and wear resistant alloys.

A. M. Roberts, formerly chief metallurgist for the American Chain Div., American Chain & Cable Co., has been promoted to the position of assistant to the plant manager.

C. H. Raab has been appointed chief metallurgist to succeed Mr. Roberts.

B. E. Anderson has assumed the position of chief engineer of Federated Metals Div., American Smelting and Refining Co. Other new assignments in the division include **Arthur F. Kohn, Jr.,** who has become assistant to the general manager, and **Robert Dean Mathis,** named superintendent of the Division's Los Angeles plant.

Frank S. Brewster has been advanced to director of research and development, Brumley-Donaldson Co.

William P. Crawley has been named supervising textile engineer to establish and operate a textile plant for Carborundum Co. The new plant will manufacture Fiberfrax fiber in roving, yarn, rope, fabric and tape forms.

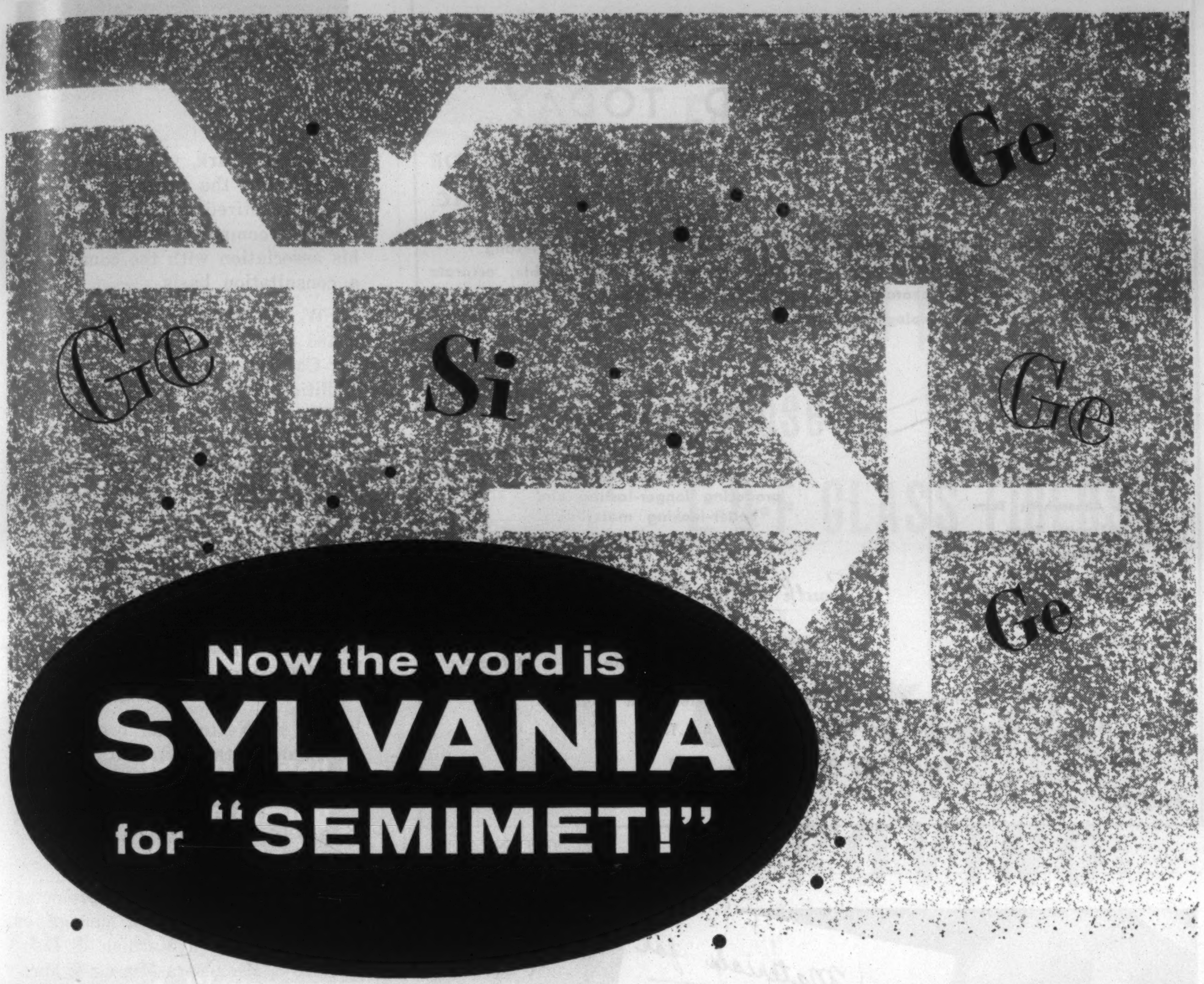
Carl Joseph Murray has been appointed works manager of the Buffalo, N. Y., plant of Colorado Fuel and Iron Corp.'s Wickwire Spencer Steel Div.

Kenneth M. Gleszer has been made executive vice president, Dixon Sintaloy, Inc.

Harold Ruehl has been named chief engineer, Erickson Tool Co.

W. Mayo Smith, Jr., has been appointed assistant director of research for Escambia Bay Chemical Corp.

(More News on p 252)



Now the word is
SYLVANIA
for "SEMIMET!"

... your single source for both
transistor-grade silicon and germanium

Sylvania has long been a primary refiner of high-purity germanium. Now, newly completed facilities for the production of high purity silicon are operating on a pilot plant basis, producing the semimetal in needle or densified form, of spectrographic purity. Full production is expected in the spring. At present, transistor-grade samples are available for your testing on a letterhead request basis.

Specifications for Sylvania germanium dioxide and semimetal include ingot as-reduced (guaranteed 5 ohm cm resistivity) and polycrystalline ingot (guaranteed minimum 30 ohm cm resistivity). Whichever grade you prefer, you can be sure of continuing high quality and uniformity when you order from Sylvania.

If you use semimetals in your products . . . or plan to in the future . . . write for technical specifications and quotations on Sylvania silicon and germanium. Remember, too, that our engineering staff is always ready to help you solve semimetal application problems.

SYLVANIA ELECTRIC PRODUCTS INC.
1740 Broadway, New York 19, N. Y.
In Canada: Sylvania Electric (Canada) Ltd.,
University Tower Bldg., St. Catherine St.,
Montreal, P. Q.

SYLVANIA®

LIGHTING • RADIO • ELECTRONICS • TELEVISION • ATOMIC ENERGY

For more information, turn to Reader Service Card, Circle No. 483

For more information, turn to Reader Service Card, Circle No. 487

"TOMORROW'S PRODUCTS TESTED TODAY" ®

South Florida IS THE NATION'S PROVING GROUNDS FOR PAINTS, FABRICS, PLASTICS, TEXTILES, RUBBER, ETC.

Southern Florida offers the BEST location in the U. S. for exposure testing Actual weathering and sun tests which are scientifically controlled, reliable, accurate and time saving. Complete laboratory for precise inspection. Measuring and recording of solar and other climatological data made directly at our proving grounds.

SCOPE OF SERVICE
Weathering and Sunlight Tests
Tidewater and Total Immersion Tests
Salt Atmospheric Tests
Termite Tests
Storage Tests
Service Tests on Mechanical Equipment and Apparatus
Inspection and Reports

We have four locations in southern Florida for inland and marine exposures

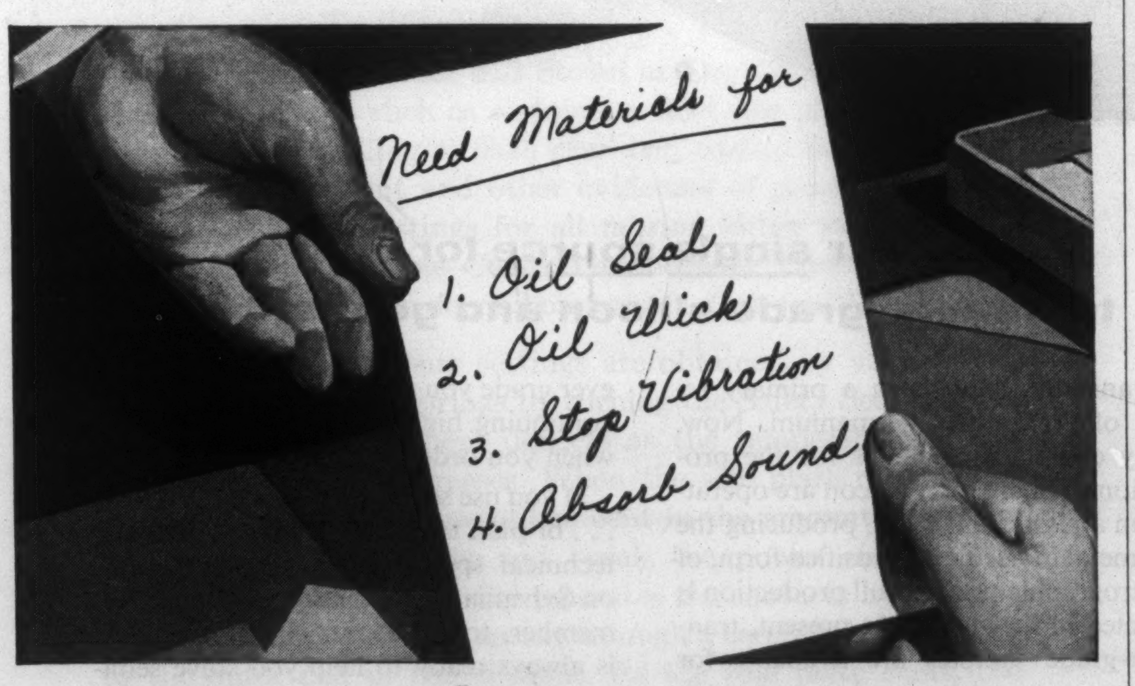
"A service to aid industry in producing longer-lasting and better-looking materials and products"

South Florida Test Service
Est. 1931
4201 N. W. 7th STREET, MIAMI 34, FLORIDA

Inspection—Testing—Research—Registered Professional Engineers
Members: Amer. Council Ind. Labs., A.S.T.M., A.A.T.C.C., S.P.I., A.S.A.

Visit Our Booth No. 311

®Reg. U. S. Patent office



FOR ALL FOUR YOUR BEST ANSWER IS

Felt

Western Felts can be made as soft as virgin wool or as hard as bone—or any desired specifications in between. But always, their live fibers hold their shape. They never ravel or fray . . . resist wear, age, and weather.

For over 56 years Western Felt has manufactured and cut specification felts for all industries. Whatever your problem, our experience can be helpful. Let our engineers investigate that possibility for you.

MANUFACTURERS AND CUTTERS OF WOOL FELTS

WESTERN Felt WORKS
4021-4139 Ogden Ave
Chicago 23, Illinois
Branches in all Principal Cities

For more information, turn to Reader Service Card, Circle No. 484

news of ENGINEERS

George H. Clark, vice president and assistant to the president, Formica Co., has retired from active service with the company. He will continue his association with the company on a consultation basis.

P. W. Litchfield, chairman of the board of The Goodyear Tire & Rubber Co., has relinquished his responsibilities as the company's chief executive officer and turned them over to **E. J. Thomas**, president. **T. A. Knowles** has replaced Mr. Litchfield as president of Goodyear Aircraft Corp.

Dr. W. A. Wesley has been awarded the 1955-56 Hothersall Memorial Medal by the Institute of Metal Finishing for his outstanding work in the electrodeposition field. Dr. Wesley is manager of the Research Lab., International Nickel Co., Inc.

Henry K. Norton has been elected chairman of the board of directors, Walter Kidde Nuclear Laboratories, Inc.

Arthur O. Black has been elected president of Magnetics, Inc.

Erwin W. Brown has been promoted to general manager in charge of plastics, Irvington Varnish & Insulator Div., Minnesota Mining & Manufacturing Co.

W. D. Kleppinger has been appointed executive assistant to the president of Mycalex Corp. of America and associated companies.

Lloyd J. Breidenbach has been made assistant general manager of Narmco Resins and Coatings Co.

Dr. James I. Hoffman has been selected to head the National Bureau of Standards' Metallurgy Div.

Benjamin F. Walkup has been advanced to the new post of chief mechanical engineer in the Administrative Engineering Dept., Owens-Illinois Glass Co. He has been assigned to the Owens-Illinois Technical Center.

Dr. Richard A. Dodd has been appointed to the faculty of the School of Metallurgical Engineering, University of Pennsylvania, as an assistant professor of metallurgical engineering.

Eugene Salinger has been made assistant general manager, Riverside Metal Div., H. K. Porter Co., Inc.

Ronald L. Loup has been appointed director of engineering for all divi-

Ideally suited for:

- Preforming
- Rod stock
- Molding compounds
- Mat
- Woven roving

For greater wet-strength retention in reinforced plastics, choose L·O·F GLASS FIBERS' Garan® ROVING

GREATER WET STRENGTH

Because of the superior wetting-out properties of Garan roving, you will be able to achieve a better bond between resin and reinforcement! This means that you will have a laminate that retains its strength, even after prolonged exposure to moisture—moisture absorption after 24-hour immersion is less than 0.1%!

GREATER FLEXURAL STRENGTH

Repeated tests have shown Garan roving-reinforced polyester plastics have considerably higher flexural strength—both wet and dry—than most other laminates!

GREATER TRANSLUCENCY

Because of Garanized roving's faster wetting-out, it gives polyester-reinforced plastics a remarkably high degree of translucency, without streaking! Garanized roving is highly uniform . . . assuring consistent and reliable performance of the laminate!

Garan roving is exclusive with L·O·F Glass Fibers Company. For complete details about types and applications, write: L·O·F Glass Fibers Company, Dept. 37-66, 1810 Madison Avenue, Toledo 1, Ohio.

Be sure to visit us at Booth 306, National Plastics Exposition, June 11 to 15, New York City.

LOF GLASS FIBERS Garan® ROVING

L·O·F GLASS FIBERS COMPANY

TOLEDO 1, OHIO

Makers of glass fibers by the exclusive "Electronic-Extrusion" process

For more information, turn to Reader Service Card, Circle No. 538

For more information, turn to Reader Service Card, Circle No. 454

Weld Your Own Corrosion Resistant Plastic Fabrications At Lower Cost With The AGILE "Do-It-Yourself" Kit

■ For frequent or occasional use in the plant or in the field, fast, sure, economical maintenance operations on thermo-plastic fabrications are now possible with this "Do-It-Yourself" Welding Kit. All the necessary tools and supplies are contained in this kit, plus detailed information guaranteeing a successful welding job.

This kit includes: (1) a 110-v. welding gun with nozzle; (2) 15 feet of nitrogen hose; (3) electrical connections; (4) a nitrogen flow-meter with tubing; (5) a contour marker; (6) a porosity spark tester; (7) marking crayons; (8) a cutting-trimming knife; and (9) two books on the subject of plastic welding.

To Meet Your Needs for Plastic Materials, Fabrications, and Fabrication Equipment, American Agile offers...

. . . semi-finished component parts of polyethylene and polyvinyl chloride, component parts for welded fabrications, large moldings, weldments, spraying and fluidizing equipment.

Write For Our Complete Catalog — it's free of course

AGILENE AGILIDE

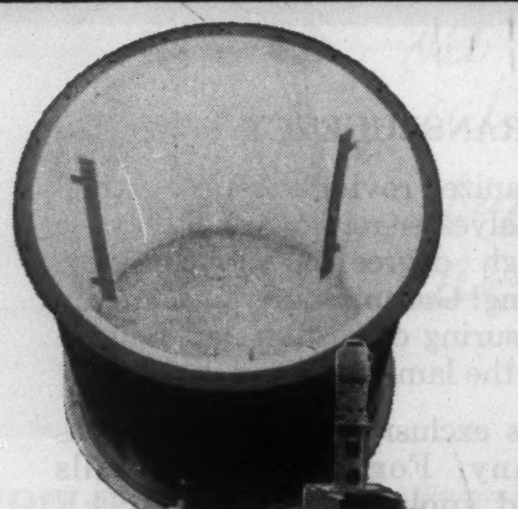
AMERICAN AGILE CORP.

Plant and General Offices • 5461 Dunham Rd. • Maple Hts., O.
Mailing Address, P. O. Box 168 • Bedford, O.

McDANEL

TANK LINING

CLEAN! PURE! NON-CONTAMINATING!



New 60" x 60" tank with agitator, lined with McDanel Lining Brick. Soon to be used by one of the nation's largest manufacturers of appliances.

● Tank's contents are guaranteed safe storage until used. McDanel Lining Brick does not contaminate or alter formula of tank's contents. Has excellent resistance to corrosion and chemical action. Fins or other protrusions from inside walls offer no installation problem. McDanel Lining Brick sets easily around sides and bottom. Broken joint installation provides custom fit for every size tank.

McDANEL Industrial CERAMICS

McDANEL
REFRACTORY PORCELAIN COMPANY
BEAVER FALLS · PENNSYLVANIA

Write today for Bulletin B1-55 on McDanel Tank and Mill Lining Products

For more information, turn to Reader Service Card, Circle No. 393

news of | ENGINEERS

sions of Progressive Welder Sales Co.

Harold B. Richmond, board chairman, General Radio Co., has received the Scientific Apparatus Makers Award "in recognition of his leadership, vision and devotion to the growth and progress of the scientific instrument industry."

Dr. Murray C. Udy has become affiliated with Strategic-Udy Processes, Inc., as director of research.

Alfred H. Stullick has been appointed foundry superintendent and **Peter Jelby** chief engineer, of Superior Brass Works, Inc.

Edward T. Wayne, formerly design engineer, E. H. Titchener & Co., has been promoted to vice president and director of engineering.

Dr. Hendrik C. J. de Decker, Dr. **Fedde H. D. Akkerman**, and Dr. **Sjirk van der Burg** have joined the staff of the Research and Development Dept., U. S. Rubber Co. All three scientists were formerly associated with Rubber-Stichting, Delft, Holland.

Charles E. Boak has been appointed manager of the Fabricating Div., The Plume & Atwood Mfg. Co., and **John Boak**, manager of the company's Mill Div.

James M. Phillips has been elected vice-president, engineering, Salem-Brosius, Inc.

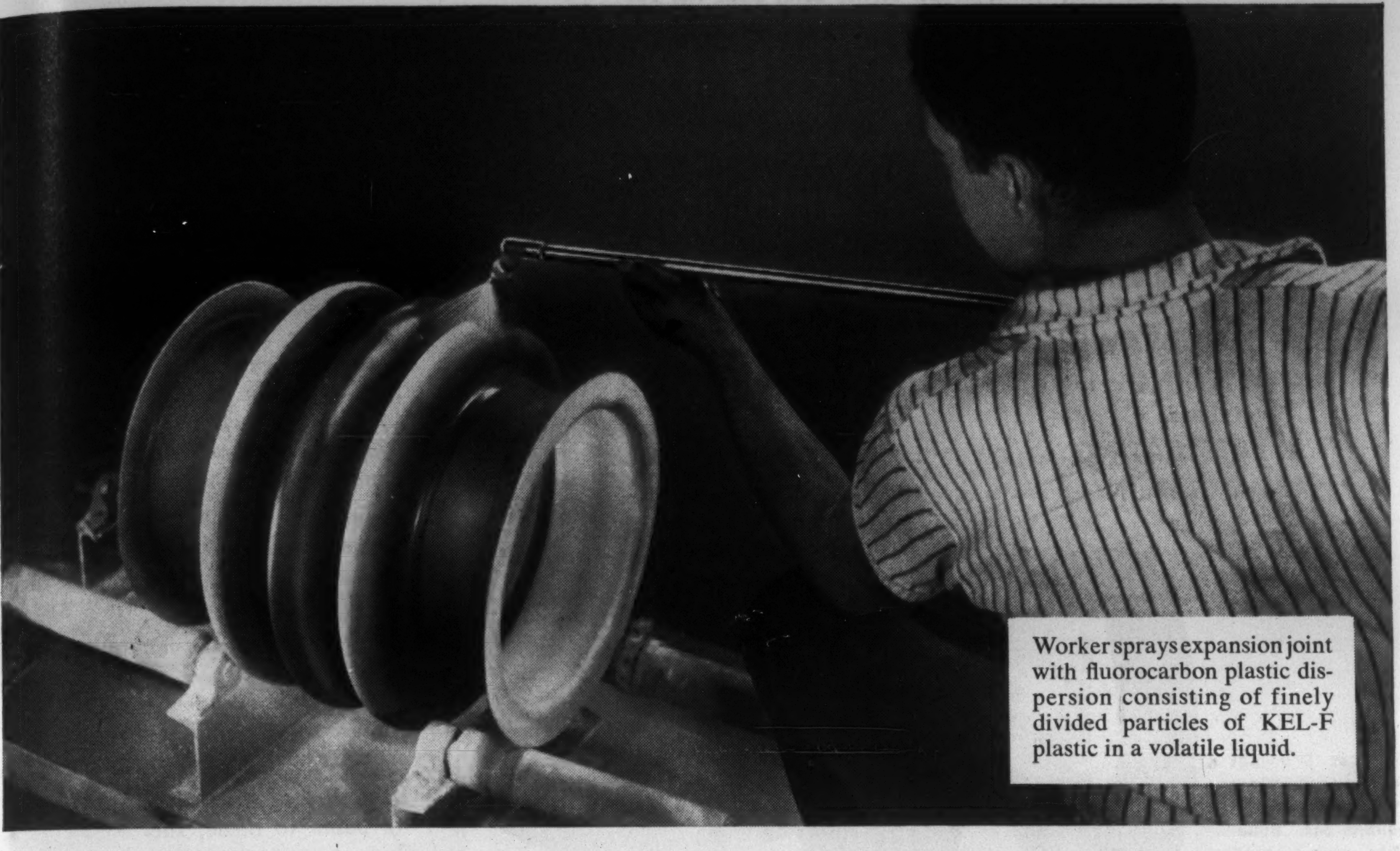
Edward C. Light has been made vice-president of Summes Gyroscope Co.'s newly formed Research and Quality Div. and a member of the board of directors.

Frank B. Jewett, Jr., has been elected a vice president and a member of the board of directors, Vitro Corp. of America.

Roger F. Waindle, president, Wai-Met Engineering Co., and vice president, The Misco Corp., has been sworn in as chief, Castings Branch, Iron and Steel Div., Business and Defense Services Administration, U. S. Dept. of Commerce.

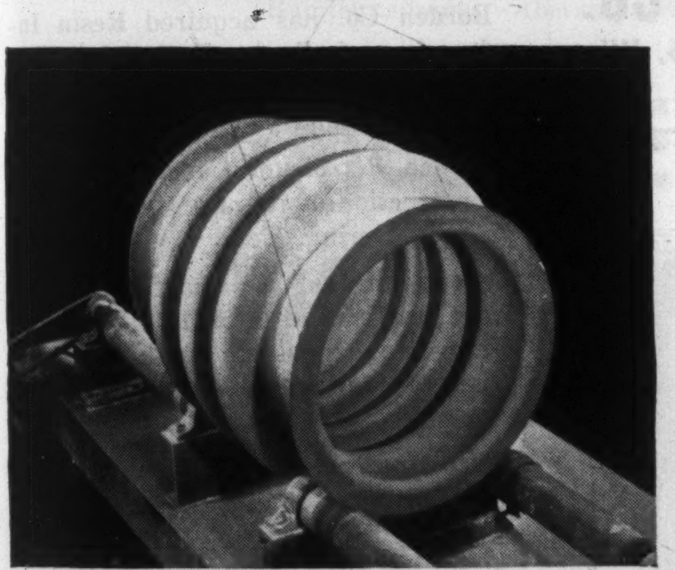
Dr. Edward R. Weidlein has retired from the presidency of The Mellon Institute of Industrial Research. He will remain on the Board of Trustees and will be available in an advisory capacity in the administration of the Institute's research programs.

(News of Companies on p 256)



Worker sprays expansion joint with fluorocarbon plastic dispersion consisting of finely divided particles of KEL-F plastic in a volatile liquid.

KEL-F® FLUOROCARBON DISPERSIONS...



Air-dried coating shows uniform coverage of both interior and exterior surfaces with tiny particles of KEL-F plastic.

for corrosion-resistant, protective coatings with anti-adhesive properties

With the new *dispersion* form of KEL-F fluorocarbon plastic, a number of surfaces can be protected with permanent, corrosion-resistant coatings.

KEL-F Dispersions are finely divided particles of KEL-F plastic in a volatile medium. They can be applied by spraying, dip, or spreading to a variety of metallic and certain non-metallic surfaces. High temperature baking fuses the dispersions into tough, adherent coatings that are corrosion-resistant, thermally stable, and anti-sticking.

Thus, fluorocarbon coatings not only protect process equipment from corrosion, but also provide a self-cleaning, non-contaminating surface that insures purity of process stream.

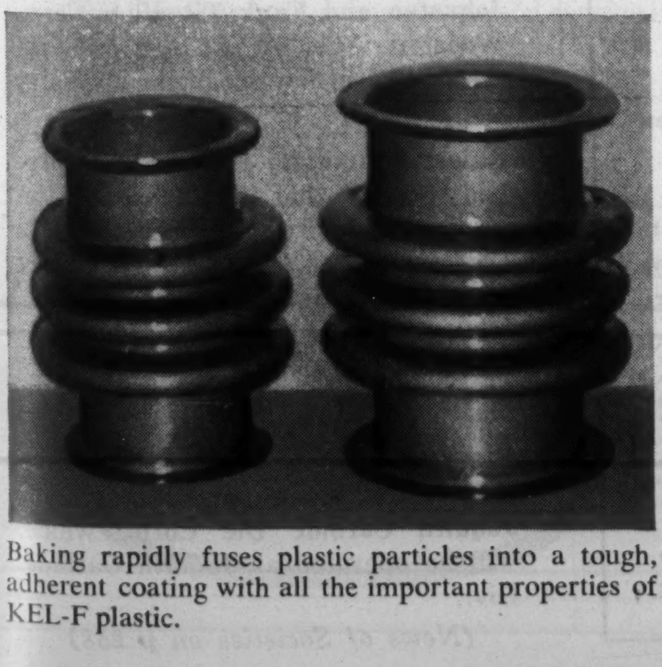
A unique combination of properties of the coatings suggests many areas of use:

CORROSION RESISTANCE—tankcars, piping, pumps, mixers, valves, flow-meters, reactors, containers.

ANTI-STICKING—agitators, calender and guide rolls, forming dies, cone blenders, casting molds.

ELECTRICAL—coated glass tape, distribution transformers, miniaturized stators and relays.

Kellogg will gladly work with you in developing specific applications for KEL-F Dispersions. If you do not maintain your own coating department, we can recommend experienced applicators. Write for more information.



Baking rapidly fuses plastic particles into a tough, adherent coating with all the important properties of KEL-F plastic.

THE M. W. KELLOGG COMPANY
Subsidiary of Pullman Incorporated
Chemical Manufacturing Division
P. O. Box 469, Jersey City 3, N. J.

®KEL-F is a registered trademark of The M. W. Kellogg Co. for its fluorocarbon products.

For more information, turn to Reader Service Card, Circle No. 442

For more information, turn to Reader Service Card, Circle No. 500

Phoenixspun FABRICATING...

Close tolerance production from steel, stainless steel, aluminum, magnesium, titanium and other types of metals.

- METAL SPINNING—Up to 180 Inches Diameter on World's Largest Horizontal Spindle Lathe.
- DEEP DRAWING—Up to 350 Tons
- WELDING—Inert Gas, Arc, Oxyacetylene.
- FABRICATING
- ASSEMBLING

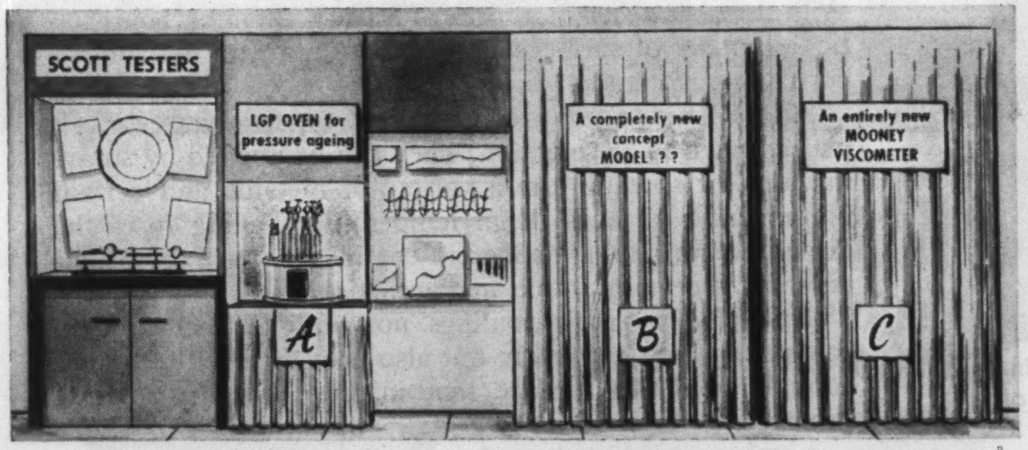
- Your Drawings and Specifications will bring prompt quotations. Bulletins upon request.

Aluminum Container Components for Ordnance (61-S-T6)

Aluminum Fairing 32" Dia. x 53" High

Metal Spinning Div. PHOENIX PRODUCTS CO.
4719 N. 27th Street
Milwaukee 16, Wis.

At the ASTM Show Booths 8 and 9:


SCOTT TESTERS
LGP OVEN for pressure ageing
A completely new concept MODEL ? ?
An entirely new MOONEY VISCOMETER
A
B
C

They're ALL N-E-W!

A Exhibited for the FIRST TIME Scott Aluminum Block Oven for pressure ageing of elastomers in air or oxygen.

B A COMPLETELY NEW CONCEPT unlike any previous Scott Tester. The most versatile and precise testing instrument ever presented for fulfilling test specifications of all organizations.

C An ENTIRELY NEW Mooney Viscometer with important improved features.

See them at Booths 8 and 9, ASTM Show. Request literature if not attending.

SCOTT TESTERS, INC.
65 Blackstone St.
Providence, R. I.

For more information, turn to Reader Service Card, Circle No. 562

news of COMPANIES

Air Reduction Chemical Co. has begun production at its new vinyl acetate monomer plant at Calvert City, Ky.

Allegheny Ludlum Steel Corp. and **National Lead Co.** have announced plans for a 67% expansion of sponge production at the jointly owned **Titanium Metals Corp.** of **America** plant.

Aluminum Co. of America has announced plans to construct a 150,000-ton smelting plant near Evansville, Ind.

Barry Controls, Inc. has arranged to purchase all physical assets of **U. S. Sheet Metal Products Co.** The newly acquired plant will operate as the Western Div. of Barry Controls.

Basic Refractories, Inc., has changed its name to Basic, Inc.

E. W. Bliss Co. has purchased controlling interest in **Matteson Equipment Co.**

Borden Co. has acquired Resin Industries of Santa Barbara, Calif., which will be operated as a wholly owned subsidiary.

Cosden Petroleum Corp. has begun construction of its new styrene plant at Big Spring, Tex.

Foote Mineral Co. has announced that the exchange of 169,178 of its shares for the assets and business of **Electro Manganese Corp.** has been completed.

Ford Instrument Co. has revealed the formation of a new Missile Development Div.

B. F. Goodrich Chemical Co. has announced an $8,000,000 expansion program for its Avon Lake, Ohio, plant.

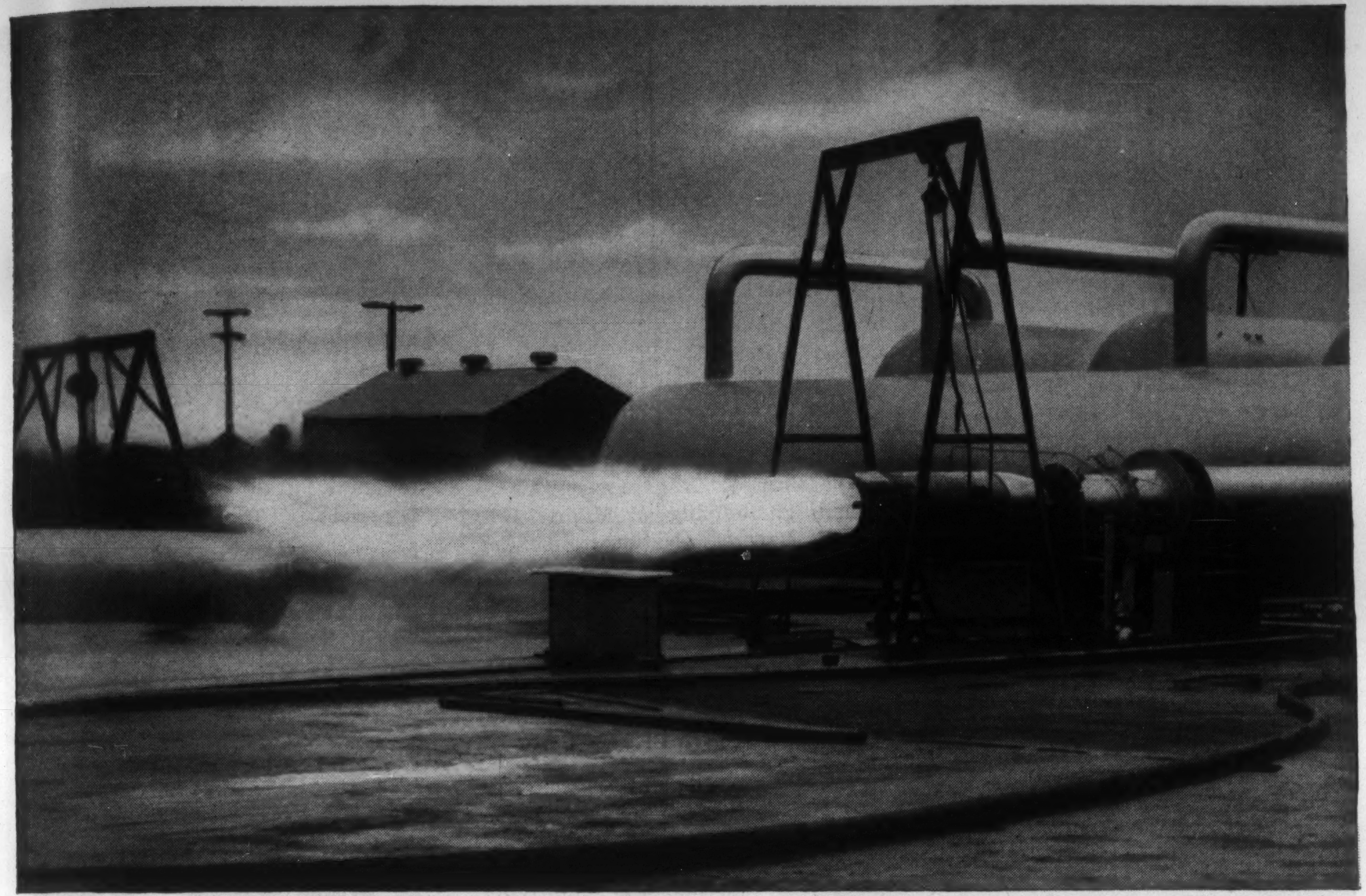
Johnston and Funk Titanium Corp., Wooster, Ohio, was organized recently and is now producing specialty titanium wire.

Kaiser Aluminum & Chemical Corp. has revealed that it will expand the primary aluminum capacity of its Chalmette, La., reduction plant by 55 million pounds annually.

The Masland Duraleather Co. has reported its entry into the rigid vinyl plastic field.

Pratt & Whitney Co., Inc., has purchased the assets and business of **Jaquith Carbide Die Corp.,** which will be operated as Jaquith Carbide Div.

(News of Societies on p 258)



Ramjet tailpipes withstand severe abuse. (*Photo courtesy Marquardt Aircraft Company*)

MULTIMET Alloy Controls the Blast of Ramjet Engines

Tailpipes used to direct the searing blast of power in today's ramjet engines must withstand temperatures in excess of 2000 deg. F, plus severe vibration. High-speed ramjets operate in the neighborhood of 1500 mph. At these high speeds, vibration is almost as serious a threat to tailpipe life as heat. Because of its strength at high temperatures, MULTIMET alloy has given good service in tailpipes that vibrate as much as three inches.

Ramjet tailpipes are made of MULTIMET alloy sheet that is only 0.051 to 0.078 in. thick. The combined high-temperature strength and oxidation resistance of MULTIMET alloy permits the use of lightweight tailpipes with good heat-transfer properties.

MULTIMET alloy is one of many HAYNES alloys capable of extending the life of parts used at high temperatures. For literature describing the properties of HAYNES high-temperature alloys, get in touch with the nearest Haynes Stellite Company Office.

HAYNES
TRADE-MARK
ALLOYS

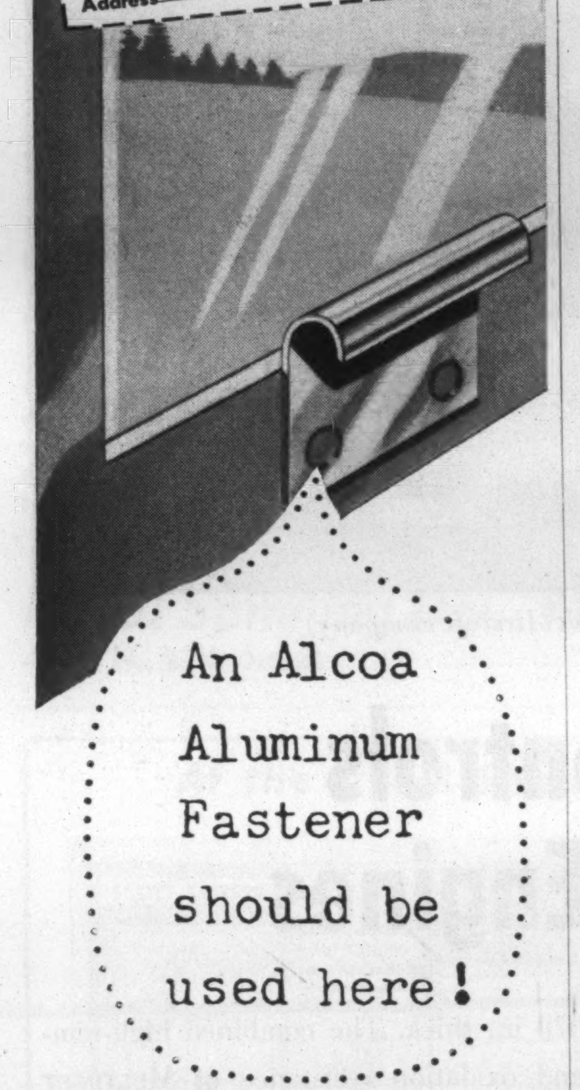
HAYNES STELLITE COMPANY
A Division of Union Carbide and Carbon Corporation
UCC
General Offices and Works, Kokomo, Indiana
Sales Offices
Chicago • Cleveland • Detroit • Houston • Los Angeles • New York • San Francisco • Tulsa

"Haynes" and "Multimet" are registered trade-marks of Union Carbide and Carbon Corporation.

For more information, turn to Reader Service Card, Circle No. 443

FILL OUT COUPON
FOR FACTS, SAMPLES

ALUMINUM COMPANY
OF AMERICA
2251-F Alcoa Bldg., Pittsburgh 19, Pa.
Gentlemen:
Please send complete specification data and samples of your aluminum fasteners.
Name
Title
Company
Address


An Alcoa Aluminum Fastener should be used here!

It's an aluminum window lift assembly, worth the lasting strength of Alcoa® Aluminum Fasteners. You avoid galvanic and atmospheric corrosion. You get perfect color match; you get the very highest quality product. Your local Alcoa distributor has a complete stock.

P. S. In this window lift assembly, we suggest an aluminum 78° countersunk rivet. One of Alcoa's complete line of aluminum fasteners.

THE ALCOA HOUR
TELEVISION'S FINEST LIVE DRAMA
ALTERNATE SUNDAY EVENINGS

YOUR GUIDE TO
THE BEST IN
ALUMINUM VALUE

ALCOA
ALUMINUM
FASTENERS

For more information, Circle No. 523

news of | SOCIETIES

The American Society of Mechanical Engineers has named John Thomas Reid as research manager.

The American Zinc Institute has elected the following directors for the term ending April, 1959: K. C. Brownell and S. D. Strauss, American Smelting & Refining Co.; E. R. Dondorf, National Lead Co.; Andrew Fletcher and C. R. Ince, St. Joseph Lead Co.; G. H. LeFevre, U. S. Smelting, Refining & Mining Co.; W. H. Leverett, National Zinc Co., Inc.; E. S. McGlone, Anaconda Co.; E. H. Snyder, Combined Metals Reduction Co.; and Jean Vuillequez, The American Metal Co., Ltd.

The Investment Casting Institute has elected as a director William I. Matthes, executive vice president of Arwood Precision Casting Co.

The National Screw Machine Products Assn. has awarded three of its members gold plated and engraved measuring micrometers, signifying the completion of 40 years connected with the screw machine products industry, of which at least 20 were in an executive position. Those honored were Harry L. Adams, vice president and general manager, Weatherhead Co. of Canada; William E. Bechmann, Western Machine Co.; and Henry A. Mueller, president, Mueller Machine Products, Inc.

The Association has also elected the following officers: Clarence A. Button, assistant to the executive vice president, Mueller Brass Co., as president; Dana B. Jefferson, Jr., president, Walker Manufacturing Co., as vice president; and Leonard R. Schaffer, president and treasurer, Mechanical Art Works, Inc., as treasurer. Orrin B. Werntz was re-elected executive vice president, and Margaret S. Ballinger was re-elected secretary.

The Scientific Apparatus Makers Assn., at its recent annual meeting, re-elected its president, Henry F. Dever. Mr. Dever is president of the Brown Instrument Div., Minneapolis-Honeywell Regulator Co. R. E. Welch, vice president and treasurer, W. M. Welch Manufacturing Co., was re-elected president pro tempore, and T. M. Mints, president, E. H. Sargent and Co., was re-elected treasurer.

(Meetings & Expositions on p 260)

Check ✓
AND
Compare

the features of
NEW LUSTER-ON
ALUMINUM SEALER
with the process
you are now using

Luster-on®
ALUMINUM SEALER

- ✓ produces a chromate film on aluminum that provides excellent corrosion protection and serves as an ideal paint base
- ✓ is an excellent substitute for anodizing in many applications where hardness is not a prime factor — gives better corrosion protection than anodizing.
- ✓ is easily applied at room temperature by dipping, spraying or brushing — treatment time extremely short.
- ✓ can be furnished in clear, yellow and dyed color finishes
- ✓ gives maximum salt spray resistance
- ✓ adheres well, does not leach easily
- ✓ offers extreme economy of use
- ✓ meets government specifications MILC-5541

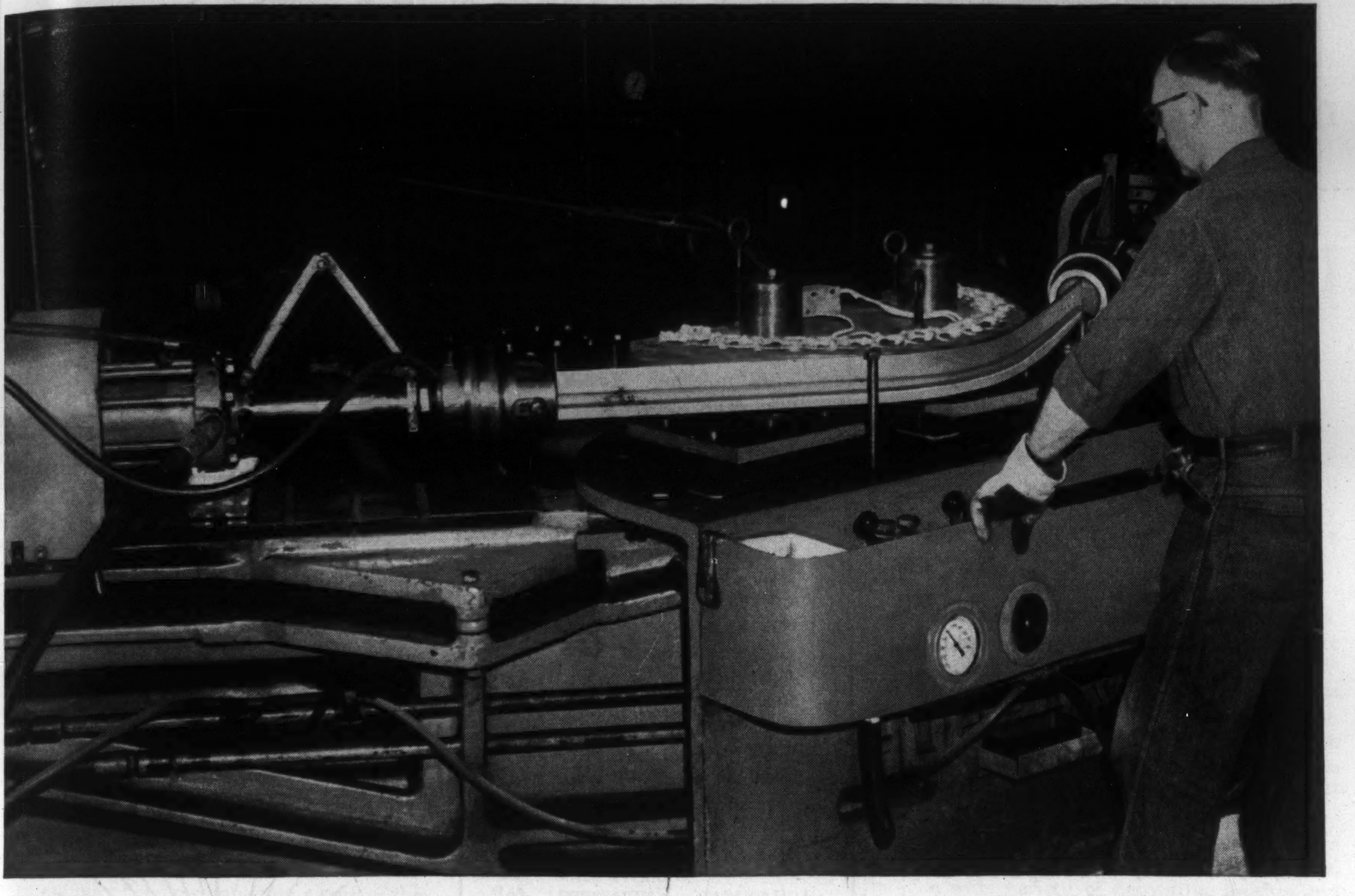
See for yourself the superior results obtained with new Luster-On Aluminum Sealer.

Send sample for free laboratory treatment.

THE Chemical
CORPORATION
67 Waltham Avenue, Springfield, Mass.

For more information, Circle No. 418

MALLORY·SHARON reports on TITANIUM



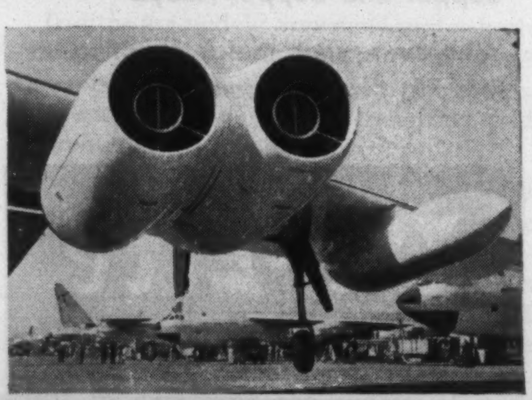
Certified titanium strength helps Bell Aircraft cut fabrication time

● In stretch forming titanium sheet parts, Bell Aircraft found variable springback an annoying problem—requiring expensive hand line-up and re-working. Springback variations of several degrees were encountered with sheets of different strength levels.

Mallory-Sharon's strength certification has aided Bell's successful effort to reduce time, work and scrap loss in titanium fabrication. Using statistical quality control, we certify the average strength of each titanium heat, and further certify that 97.5% of the heat lies within narrow limits of this value (such as ± 5000 psi).

This simplifies segregation of incoming material into close strength ranges. Bell color codes and handles each strength level separately. In addition, hot forming techniques have been perfected to reduce variable springback.

Quality certification is *another first* from Mallory-Sharon contributing to the rapid advance of this new metal. Call us for your requirements in titanium and titanium alloy mill products, and for technical assistance in application.



Bell Aircraft produces complete engine pods for the Boeing B-52 jet bomber. Extensive use of titanium in these pods saves approximately 400 pounds gross.

MALLORY-SHARON TITANIUM CORPORATION, NILES, OHIO

MALLORY Ti SHARON

• For more information, turn to Reader Service Card, Circle No. 505

SPECIFICATIONS
PART
MAT.
FINISH DU-LITE
REF.
DRG.
SCALE

you can

DEPEND ON

Du-Lite

to meet your specifications

Du-Lite black oxide finishes for steel, stainless, copper, zinc or malleable iron provide a uniform, durable surface without altering the dimensions or physical characteristics of the metal. That's why they are often specified right on the blueprint.

And since the Du-Lite process is simple, flexible, and imposed at non-critical temperatures, you can depend on the results to meet your specifications—always.

Du-Lite black oxide finishes also meet govt. specs. MIL-F-13924, superseding 57-0-2C Type III Class A for steel and Class B for stainless (Type II Class B and C phosphates), and MIL-P-12011, superseding 51-70-1A para. 22.03 Class C for Copper and Copper Alloys.

Whatever your metal cleaning or finishing problem, consult—

Du-Lite

METAL FINISHING SPECIALISTS

DU-LITE CHEMICAL CORP.
MIDDLETOWN, CONN.

Send more information on Du-Lite........... ☐
Send information on metal finishing products.. ☐
Have your representative call............ ☐

Name.................................
Company..............................
Address..............................
City.............. Zone....... State.......

For more information, Circle No. 438

Meetings and Expositions

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, Applied Mechanics Div. conference. Urbana, Ill. June 14-16.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, semi-annual meeting. Cleveland. June 17-21.

AMERICAN ELECTROPLATERS' SOCIETY, annual convention. Washington, D. C. June 17-21.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting. Atlantic City. June 18-22.

ALLOY CASTING INSTITUTE, annual meeting. Hot Springs, Va. June 24-26.

DROP FORGING ASSN., annual meeting. Hot Springs, Va. June 24-27.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, summer and Pacific general meeting. San Francisco. June 25-29.

SOCIETY OF THE PLASTICS INDUSTRY, Plastic Structures Div. conference. New York. June 26.

PORCELAIN ENAMEL INSTITUTE, porcelain enamel on aluminum conference. Cleveland. June 27.

SOCIETY OF AUTOMOTIVE ENGINEERS, West Coast meeting. San Francisco. Aug 6-8.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, fall meeting. Denver. Sep 10-12.

SOCIETY OF AUTOMOTIVE ENGINEERS, tractor meeting and production forum. Milwaukee. Sep 10-13.

AMERICAN DIE CASTING INSTITUTE, annual meeting. Chicago. Sep 11-13.

AMERICAN SOCIETY FOR TESTING MATERIALS, Pacific Coast meeting. Los Angeles. Sep 16-22.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, Instruments and Regulators Div., and Instrument Society of America, exhibit and joint conference. New York. Sep 17-21.

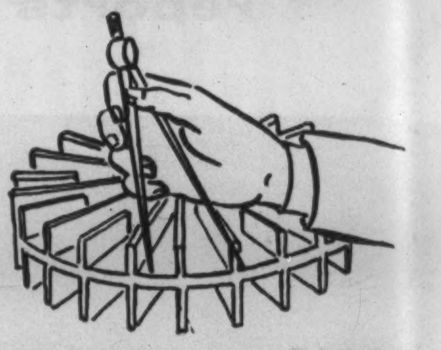
PORCELAIN ENAMEL INSTITUTE, annual meeting. Colorado Springs, Colo. Sep 19-21.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, petroleum-mechanical engineering conference. Dallas, Tex. Sep 23-26.

STEEL FOUNDERS' SOCIETY OF AMERICA, fall meeting White Sulphur Springs, W. Va. Sep 24-25.

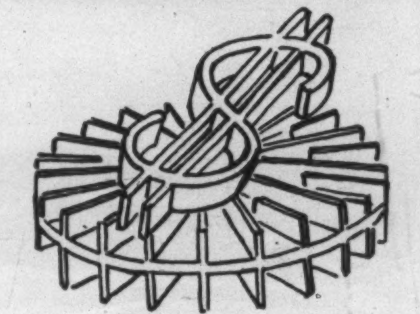
ATOMIC INDUSTRIAL FORUM, trade fair. Chicago. Sep 24-28.

DESIGN HELP

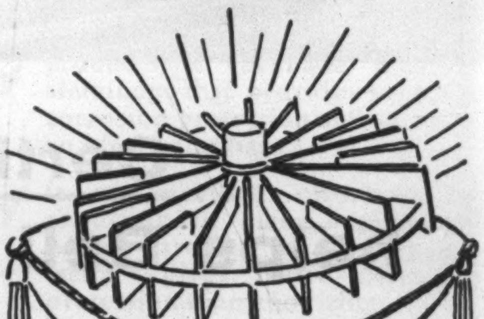


PROMPT DELIVERY

REASONABLE COST



QUALITY



Kuhn and Jacob specializes in the compression molding of thermosetting plastics.

Write for Free Catalog

KUHN & JACOB MOLDING & TOOL CO.
1203 Southard St., Trenton 8, N.J.

Represented by
S. C. Ullman
55 West 42nd St., New York, N. Y.
Phone PEnn 6-0346

Wm. A. Chalverus
Carson Road, Princeton, N. J.
Phone 1-3170-J2

Wm. T. Wyler
Box 126, Stratford, Conn.
Phone Bridgeport 7-4293

For more information, Circle No. 450

SPECIAL REPORTS ON FINISHING NON-FERROUS METALS

NUMBER III—Lustrous, Corrosion-Resistant Finishing with Chemical Polishing Iridite

WHAT IS IRIDITE®?

Briefly, Iridite is the tradename for a specialized line of chromate conversion finishes. They are generally applied by dip, some by brush or spray, at or near room temperature, with automatic equipment or manual finishing facilities. During application, a chemical reaction occurs that produces a thin (.00002″ max.) gel-like, complex chromate film of a non-porous nature on the surface of the metal. This film is an integral part of the metal itself, thus cannot flake, chip or peel. No special equipment, exhaust systems or specially trained personnel are required.

Chromate conversion coatings are widely accepted throughout industry as an economical means of providing corrosion protection, a good base for paint and decorative finishes for non-ferrous metals. Certain of these coatings also possess chemical polishing abilities that have luster-producing, as well as corrosion-inhibiting, effects on zinc and cadmium plate, zinc die castings and copper alloys. However, continued developments in this field have been so rapid that many manufacturers may not be completely aware of the breadth of application of this type of finish. Hence, this discussion of the many ways in which this chemical polishing characteristic can be used in final finishing or pre-plating treatments to produce a lustrous appearance with distinct display and sales appeal and appreciable savings in cost. Report I on decorative, corrosion-resistant finishes and Report II on paint base corrosion-resistant finishes are available on request.

The degree of luster possible on a surface is a function of the degree to which the surface can be smoothed. Leveling to provide a smooth surface can be achieved by mechanical or chemical means, or a combination of these, depending upon the luster desired and the original condition of the metal. Chemical polishing effectively imparts luster otherwise difficult and costly to obtain. For this reason, it is often used to supplement or entirely replace mechanical polishing, depending upon the application and the original condition of the metal. Chemical polishing has the additional advantage of providing overall treatment of the submerged part. It reaches into even the deepest corners and recesses that are otherwise inaccessible. Certain of the Iridites are specifically designed to perform this chemical polishing operation. Also, they provide corrosion protection as do all Iridites, thus may be used as a final finish or a pre-plating polish.

If Iridite is to be used as a final finish, in contrast to pre-plating treatment, the chromate conversion coating generated is allowed to remain, providing good corrosion resistance. Color inherent in these Iridite films ranges from a yellow cast to yellow iridescent. These coatings may be used without further treatment where this color is acceptable and good corrosion resistance is desired. Further, these basic coatings can be tinted by dyeing. Among the dye tints available are shades of red, yellow, blue and green. If desirable, the basic coatings can also be modified by a bleach dip leaving a clear bright or blue iridescent finish. In all cases bleaching reduces corrosion resistance.

As examples of this type of final finishing, Iridites #4-73 and #4-75 (Cast-Zinc-Brite) make possible for the first time, lustrous chemical polishing of the as-cast surface of zinc die castings. Thus, in many cases, sizeable savings in finishing cost are realized by elimination of plating costs. This economical method can be used on tools, appliance parts, toy pistols, locks and many other small castings. Another example is the treatment of copper and brass parts, such as welding tips, to eliminate buffing and provide additional corrosion resistance. In many cases, handling costs are reduced appreciably by replacing piece-part handling with bulk processing. Still another example of the use of this chemical polishing and protective quality of Iridite is a simple system of zinc plate, Iridite and clear lacquer instead of more costly electroplated finishes. Typical of this type of lustrous finish are builders hardware and wire goods.

As a pre-plating treatment, in contrast to final finishes, Iridite can be used to chemically polish zinc die castings or copper prior to plating. In such cases, Iridite should be applied as an in-process step, so that the protective film is removed before the plating cycle. The savings in handling, material and labor costs are obvious. This process has made it practical to plate chrome directly over copper on steel, conserving nickel, yet producing a lustrous chrome finish. Used after stripping faulty plate in reprocessing zinc die castings, Iridite restores luster to the casting, thus making possible replating without blistering.

Other Iridite finishes are available to produce maximum corrosion resistance, a wide variety of decorative finishes and excellent bases for paint on all commercial forms of the more commonly used non-ferrous metals. As a final finish, appearance ranges from clear bright to olive drab and brown and many films can be bleached or dyed. As a paint base Iridite provides excellent initial and retentive paint adhesion and a self-healing property which protects bare metal if exposed by scratching. Iridites have low electrical resistance. Some can be soldered and welded. The Iridite film itself does not affect the dimensional stability of close tolerance parts.

Iridites are widely approved under both Armed Services and industrial specifications because of their top performance, low cost and savings of materials and equipment.

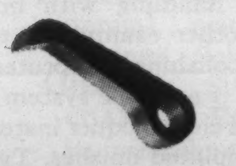
You can see then, that with the many factors to be considered, selection of the Iridite best suited to your product demands the services of a specialist. That's why Allied maintains a staff of competent Field Engineers—to help you select the Iridite to make your installation most efficient in improving the quality of your product. You'll find your Allied Field Engineer listed under "Plating Supplies" in your classified telephone book. Or, write direct and tell us your problem. Complete literature and data, as well as sample part processing, is available. Allied Research Products, Inc., 4004-06 East Monument Street, Baltimore 5, Maryland.

(Adv.)

For more information, turn to Reader Service Card, Circle No. 472

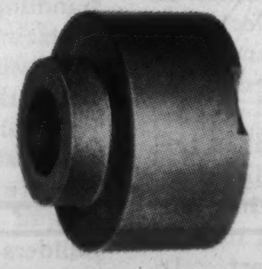
Parts costs

Typical parts being produced on Stokes Model 640 Press by International Business Machines Corporation.



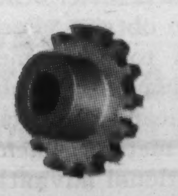
Feed pawl cost cut 64.6%

Sintered iron Tolerances:
thickness ±.002″
centerline to tip ±.002″
hole +.001″, −.000″



Roll bearing cost cut 46.6%

Sintered bronze Tolerances:
O.D. +.000″, −.001″
Bore: +.001″, −.000″
Length: ±.001″



Ratchet cost cut 49.3%

Sintered brass Tolerances:
tooth form ±.002″
bore: +.002″, −.000″

cut up to 65% at I.B.M.

—*by compacting on*

STOKES *powder metal press*

On a Stokes 50-ton Model 640 press, International Business Machines Corporation produces a variety of powder metal parts at its Endicott, N.Y. plant. Close tolerances are maintained and costs are reduced up to 65%.

This is typical of the savings that powder metal processing can effect. On Stokes fully automatic compacting presses, many parts which are wasteful of metal stock, machine time and labor when made by conventional methods can be produced in high volume . . . at low cost. This technique applies to a wide range of metals, alloys and non-metallic powders . . . either pure or mixed. It often provides qualities unobtainable in the solid metal.

35 years experience in this field is the foundation for these outstanding features of the Model 640 press . . . latest addition to the extensive Stokes line of compacting equipment.

Easy setup and control . . . press adjustments operate independently, and are centralized at the front of the press. Handwheel calibrations are direct reading.

Precise tool alignment . . . protects tools, assures precision.

Clean operation . . . totally enclosed construction.

Full pressure breakaway at initial ejection eliminates possibility of pieces fracturing. All parts are fully supported during ejection; thin-flanged parts won't break.

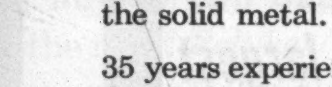
Low maintenance, maximum safety . . . *plus great flexibility.*

Find out for yourself how Stokes powder metal pressing can cut parts costs. The Stokes service includes laboratory compacting of samples parts, accurate cost analysis, and design and production of punches and dies. Write today for the following literature: "Powder Metallurgy Today"; Catalog No. 801, "Stokes Powder Metal Presses"; Bulletin No. 670, "Stokes Model 640 Powder Metal Press."

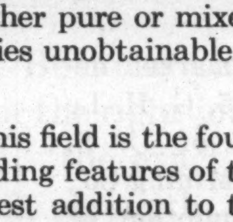
Powder Metal Press Division
F. J. STOKES CORPORATION
5514 Tabor Road, Philadelphia 20, Pa.

STOKES

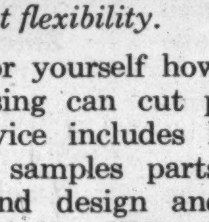
These leading custom producers profit from Stokes powder metal presses.



$25,000 yearly saved . . . $30,000 machine tool outlay avoided . . . by making lock parts on a Stokes press at Dixon Sintaloy, Inc., Stamford, Conn.

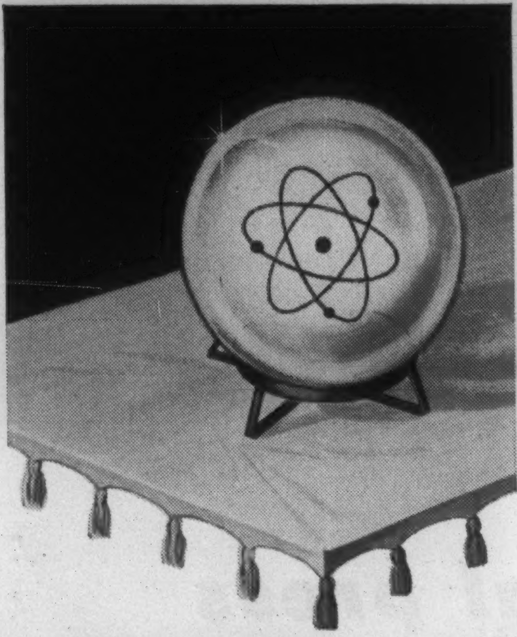


$20,000 per year cost-reduction was made on a wringer drive gear of iron and copper powder, for use on "Whirlpool" washers. Parts made by the Presmet Corporation, of Worcester, Mass. . . . on Stokes powder metal presses.



82% drop in cost is the story behind this drive gear for a home ice cream freezer . . . formed in a single operation on a Stokes press at Yale & Towne's metal products division, Franklin Park, Illinois.

For more information, turn to Reader Service Card, Circle No. 576



YOUR FUTURE in ATOMIC POWER

Atomic power, we feel, offers outstanding opportunity for an engineer or scientist to grow professionally. It's new enough so that the work is challenging; still it's well enough established so that a capable man can make real progress.

If you are interested in a nonroutine position that will use all of your education and experience, we suggest you investigate the future with the leader in Atomic Power. At Bettis Plant, there are select positions open for specially qualified:

- **PHYSICISTS**
- **MATHEMATICIANS**
- **METALLURGISTS**
- **ENGINEERS**

Write for the booklet "Tomorrow's Opportunity TODAY" that describes opportunities in your field. Be sure to indicate your specific interests.

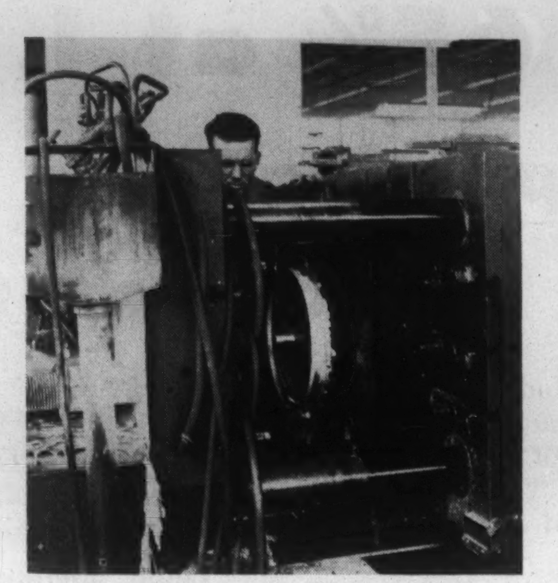
Write: Mr. A. M. Johnston
Dept. A-55
Westinghouse Bettis Plant
P. O. Box 1468
Pittsburgh 30, Penna.

BETTIS PLANT
Westinghouse
FIRST IN ATOMIC POWER

For more information, Circle No. 493

MATERIALS ENGINEERING NEWS

Continued from p 13



Lee Silver Service, Inc.

Zinc die casting *Bendix washing machine porthole ring about to be withdrawn from the die casting machine.*

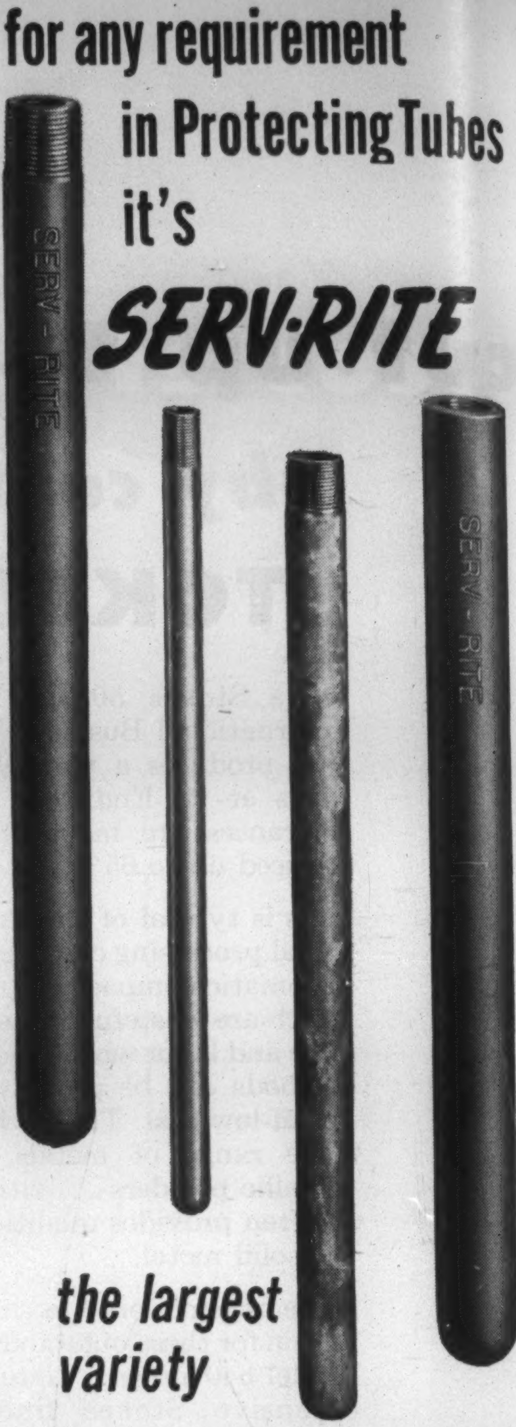
trial machinery fields.

Zinc consumption

In reviewing zinc market developments during 1955, G. H. Le Fevre, vice president of U. S. Smelting Refining and Mining Co., gave details on consumption of zinc in the major market areas. He estimated zinc consumption in the galvanizing industry at 440,000 tons. At the end of 1955, 26 continuous galvanizing lines were in operation, two were under construction, and some nine or ten more were under consideration or in the planning stage.

According to Mr. Le Fevre, the reported use of zinc in die castings stood at about 392,000 tons in 1955. The largest consumer of zinc base die castings continues to be the automobile industry. It is estimated that between 60 and 70% of the production of zinc base die castings is for this industry; between 15 and 20% is consumed by the appliance industry.

Rolled zinc and zinc used in the brass industry accounted for 145,000 and 50,000 tons of zinc respectively, during 1955. Other uses, which include stamping and forming dies, wire, powder metallurgy, electroplating, and cathodic



In size and length, in iron, nickel, and alloys, and in formed or precision drilled, Gordon has about the largest variety of thermocouple protecting tubes. And you get off-the-shelf delivery on most any of this great variety of "standard" tubes. Gordon also makes protecting tubes to specifications for special requirements.

Give Serv-Rite a trial on your next protecting tube requirements. You can't go wrong. Careful manufacture and rigid inspections assure satisfaction. Get full information today. Ask for Bulletin 11-13.

- **Bulletin 11-13 gives general application data, specifications, and ordering information on Serv-Rite protecting tubes and protecting wells—the largest grouping in one listing.**

6221

CLAUD S. GORDON CO.
Manufacturers · Engineers · Distributors

611 West 30th St., Chicago 16, Ill.
2023 Hamilton Ave., Cleveland 14, O.

For more information, Circle No. 449

Polyken Tapes have
CONTROLLED STRENGTH
(and that's what saves the money)

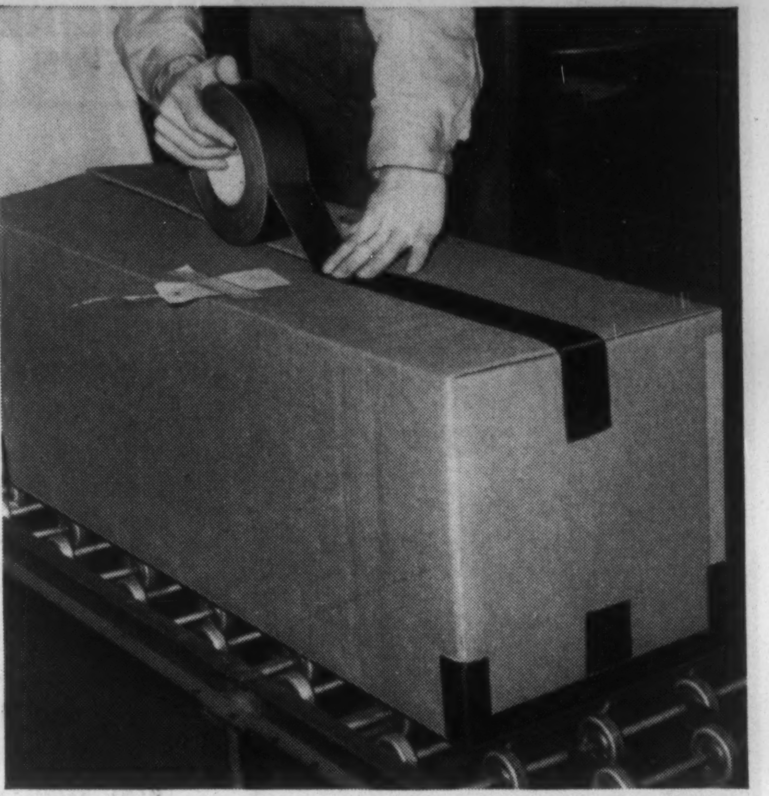
CONTROLLED STRENGTH:

the right combination of backing and adhesive to give you "all work—no waste"

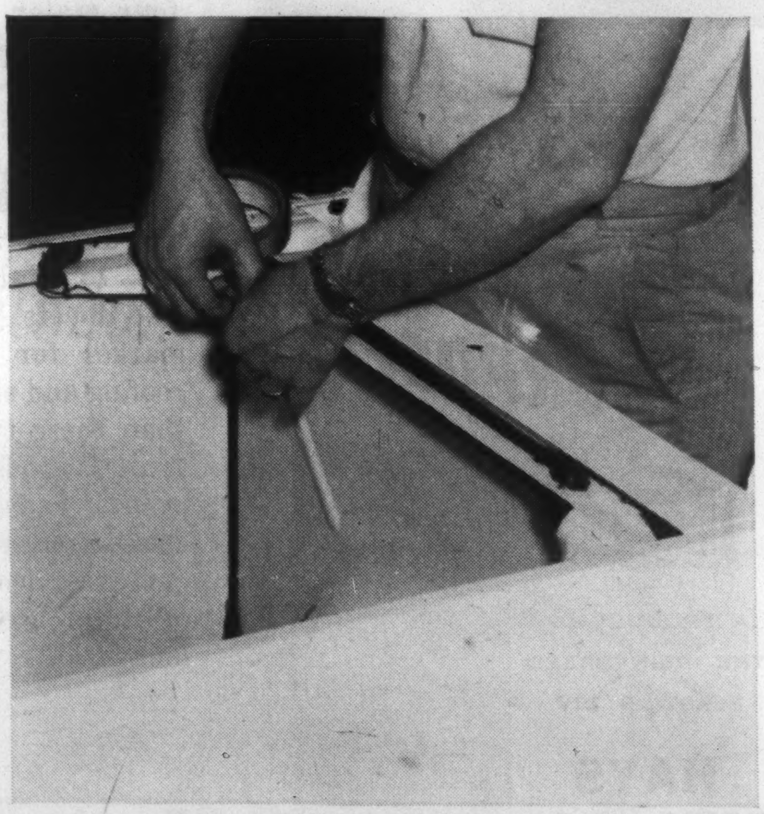
Here's how it can help you: Because you can select the right *Polyken* Tape for the right job, you get the exact sticking power . . . the exact moisture resistance, the extra tensile strength . . . the exact tear resistance you need. When you need particular qualities, there's a *Polyken* Controlled Strength Tape that has them.

That way—the Controlled Strength way—you do the job *right* for the *least* amount of money.

Take these *Polyken* waterproof tapes, for example. See how they work harder . . . give greater protection . . . through their "just right" performance on the job at hand. And that usually means a considerable saving.



Controlled Strength reduces packaging costs. This job calls for waterproof tape, but it has to be inexpensive. Low-cost *Polyken* Tape No. 216 solves the cost problem . . . sticks firmly during shipment . . . and protects against water damage and moisture . . . a "just right" selection that provides the necessary balance between quality and economy.



Controlled Strength assures a lifetime seal. Insulation in these refrigerators and freezers must be permanently sealed against damage by condensation and moisture. Premium-quality *Polyken* Tape No. 214 assures airtight lifetime protection.

Use this convenient coupon to find out how *Polyken* Controlled Strength Tapes can mean "all work—no waste" on the job for you.

Polyken, Dept. MM-F
222 West Adams St., Chicago 6, Illinois

Please send me physical properties and further information on *Polyken* Controlled Strength Tapes.

Name__________ Title__________

Company__________

Street Address__________

City__________ Zone____ State__________

Polyken®

CONTROLLED STRENGTH

INDUSTRIAL TAPES

THE KENDALL COMPANY, POLYKEN SALES DIVISION

For more information, turn to Reader Service Card, Circle No. 374

SPECIFY
*
HAYSITE
INSULATING
SHEET

* A glass reinforced alkyd base polyester insulating material designed to meet the rigid standards of the electrical industry.

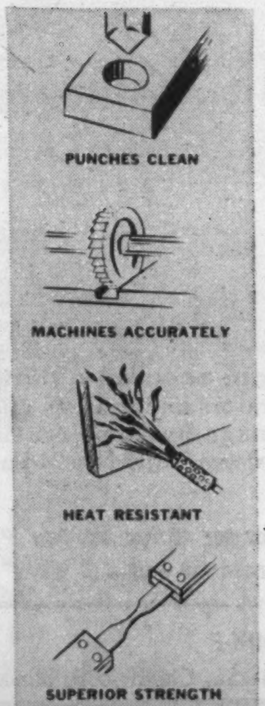
A GRADE FOR ALL CLASS B INSULATING PURPOSES.

HAYSITE

A PRODUCT OF
THE REINFORCED
PLASTICS DIV.

HAYS MFG. CO.
ERIE, PA.

WRITE
FOR COMPLETE
TECHNICAL
BROCHURE
NO.100



See us in Booth 126—National Plastics Exposition—Coliseum, New York City

For more information, Circle No. 577

protection, ran to some 52,000 tons.

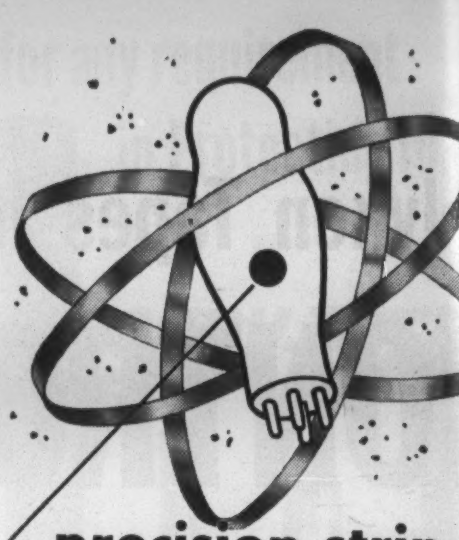
B. E. Estes, director, commercial research, U. S. Steel Corp., reported that between 65 and 75% of galvanized sheet is consumed in the construction industry. The rapid growth of this industry has helped make galvanized sheet one of the faster growing steel products, as shown by its increase from only $2\frac{1}{4}\%$ of total steel shipments in 1948 to almost $3\frac{1}{4}\%$ in 1955. In 1954 when total steel shipments declined by more than 20%, shipments of galvanized sheets actually showed a 3% increase.

Mr. Estes predicted that the four major markets which make up the construction industry will continue to take the bulk of galvanized sheet shipments. The first market is air conditioning, heating and ventilating equipment, and ductwork, which takes almost 20% of total shipments of galvanized sheets. Of equal size is the market for industrial and farm roofing and siding. Slightly smaller than these two is the market for "rain goods" — gutters, downspouts, flashing, etc. Last is the sizable market for culverts which currently accounts for about 10% of total galvanized sheet shipments.

Xerography Cuts Costs in Printed Circuit Work

Savings in material cost and production time are said to result from using the xerographic process in the preparation of printed electrical circuits for etching. The powder image peculiar to xerography—an electrostatic method of copying—is transferred from a "XeroX" selenium plate to a sheet of transfer paper and then to the face of a copper-clad laminate. The powder forms a photo-exact resist pattern impervious to chemical attack.

During the etching step, acid



precision strip for electronics applications

From 0.0005 in. to 0.040 in. thick and 0.090 to 6 in. wide, these alloys are available as special-tolerance strip:

Beryllium Copper
Phosphor Bronze
Nickel Silver
Brass
Chromium Copper
Stainless 17-7PH
Invar
Magnetic: High Nickel

Some immediately available. Others rolled to order in 2 to 21 days. Can be supplied in coils or straight lengths with slit or filed edges—also cadmium plated.

Write for Bulletin 7 TODAY.

PENN
PRECISION PRODUCTS, INC.
501 Crescent Avenue • Reading, Pa.

SALES OFFICES

New York
H. G. WILLIAMS
Ramsey, N. J.

Philadelphia
J. A. RHODES
Upper Darby, Pa.

Boston
F. G. STROKE

St. Louis
J. A. CROWE

Cleveland
L. D. ALSPACH

Houston
RANDOLPH SALES CO.

Chicago
R. A. BURKETT

Los Angeles
KRUSEN WIRE & STEEL CO.

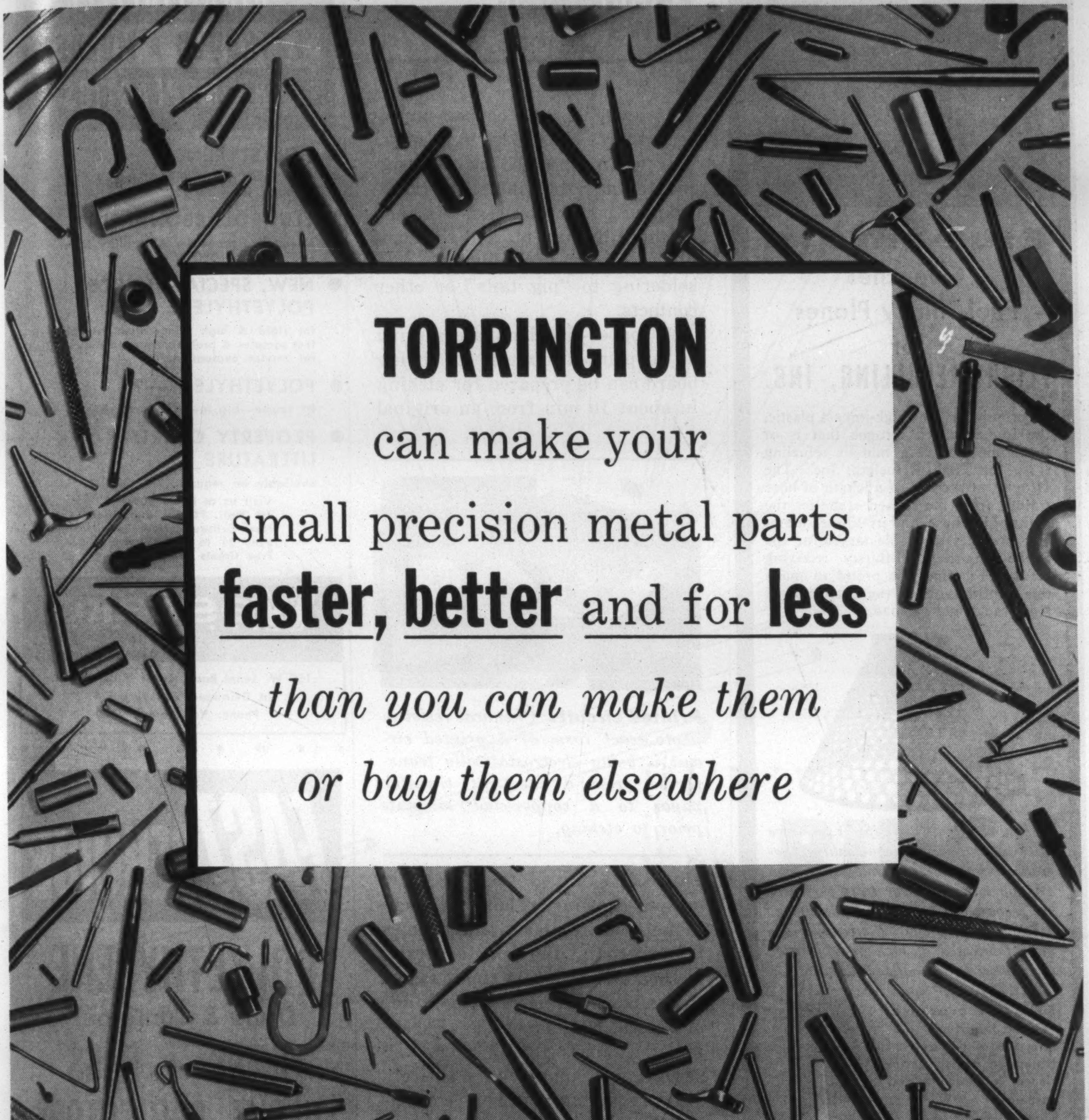
WAREHOUSES

New York
BERYLLIUM COPPER SUPPLY CO.
Little Falls, New Jersey

Chicago
PRECISION STEEL WAREHOUSE INC.

Los Angeles
KRUSEN WIRE & STEEL CO.

For more information, Circle No. 511



TORRINGTON

can make your

small precision metal parts

faster, better and for **less**

than you can make them

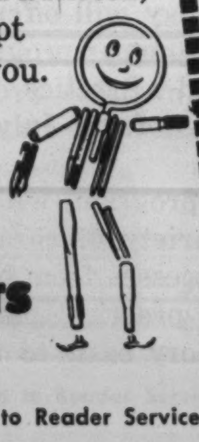
or buy them elsewhere

These are typical of parts that Torrington produces daily by the hundreds or millions. If you use similar small precision parts, mail the coupon today for the Torrington Small Precision Parts condensed catalog. Even better, send a sketch, blueprint or sample part. We will give you a prompt quotation which will mean substantial savings to you.

THE TORRINGTON COMPANY
Specialties Division
777 Field Street, Torrington, Conn.

TORRINGTON *SPECIAL* METAL PARTS

Makers of Torrington Needle Bearings



THE TORRINGTON COMPANY
Specialties Division
777 Field Street, Torrington, Conn.

☐ **Please send the Torrington Small Precision Parts condensed catalog**

☐ **Please have a salesman call**

Name__________________________________

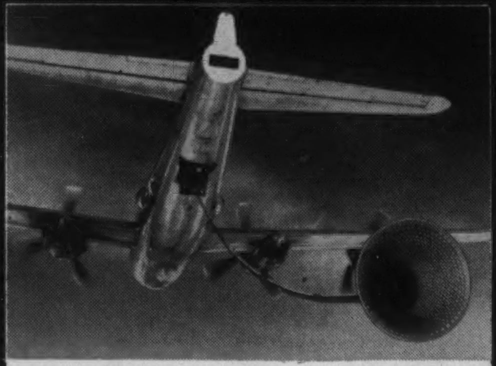
Title__________________________________

Company________________________________

Address________________________________

City______________Zone______State______

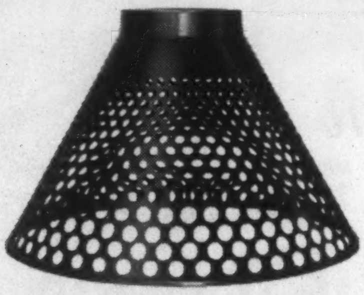
• **For more information, turn to Reader Service Card, Circle No. 422**



Fibermold

Quenches
Fuel-Thirsty Planes
for
FLIGHT REFUELING, INC.

Fibermold casts of high-impact plastic, the funnel-shaped Drogue that is of focal importance in mid-air refueling . . . for Flight Refueling, Inc. The Drogue, at the end of a length of hose trailing from the tanker, stabilizes the flight of the hose, and its 30-inch diameter provides a sizable target for the Probe on the fuel-thirsty receiving plane. Fibermold is proud to make this contribution to the extension of flight range and payload.



Fibermold puts its diversified experience to work producing high-quality, low-pressure laminates in volume for the aviation industry. Our sales engineers are prepared to assist you in designing, developing and producing aircraft structures fabricated of high-grade plastics . . . to meet your specific requirements.

Send for brochure, "Behind the Scenes" . . . complete digest of Hampden Brass's experience, equipment and facilities.

Fibermold
DIVISION
Manufacturers of
High-Grade Reinforced Plastics

HB

HAMPDEN BRASS
AND ALUMINUM CO.
Established 1903
262 Liberty St.•Springfield, Mass.

Producers of Non-Ferrous Sand, Permanent Mold & Die Castings

For more information, Circle No. 473

eats away all the copper unprotected by resist, leaving metal only where specified by the original circuit drawing. The xerographic powder or resist is then removed by solvent, and the completed print is ready for dip soldering to "pig tails" or other contacts.

A copper-clad laminate serving as a printed circuit or wiring board can be prepared for etching in about 10 min from an original opaque drawing. Thus, the technique is approximately nine times faster than the photo resist method and about 14 times faster than silk screening, the only other processes in common use. Except for the final etching step, the xerographic approach is entirely dry, requiring neither conventional photographic materials nor dark room facilities.

Printed circuits *Chemical resist in photo-exact form of a printed circuit is being electrostatically transferred from a sheet of transfer paper to a copper-clad laminate prior to etching.*

Summer Course in Ceramic Forming

The Massachusetts Institute of Technology will offer a two-week special summer program on "Theory and Practice of Ceramic Forming" from July 16 through July 27.

The program will consider a wide variety of ceramic fabrication processes from both theoretical and practical points of view. The theory basic to various proc-

HIGH FIDELITY
EXTRUDED & MOLDED
THERMOPLASTICS

- **POLYSTYRENE**
  Low cost, rigid; dimensional stability to +200°F.
- **FLUOROCARBON (Kel-F)**
  Unequalled properties & stability from —300°F. to +390°F.
- **NEW, SPECIAL-SERVICE POLYETHYLENE**
  for rigid & high temperature requirements—test samples & preliminary data now available for service evaluation.
- **POLYETHYLENE—?**
  Of course—big inventory—all sizes.
- **PROPERTY CHARTS & LITERATURE**
  available on request.

Visit us at Booth 309—
7th Natl. Plastics Exposition
New Coliseum, New York
June 11 to 15 inclusive
Free tickets on request

Westlake
plastics co.

155 W. Lenni Road, Lenni Mills, Penna.
In Delaware Valley, U.S.A.
Phone: Valleybrook 2700

* * * * * * * * * *

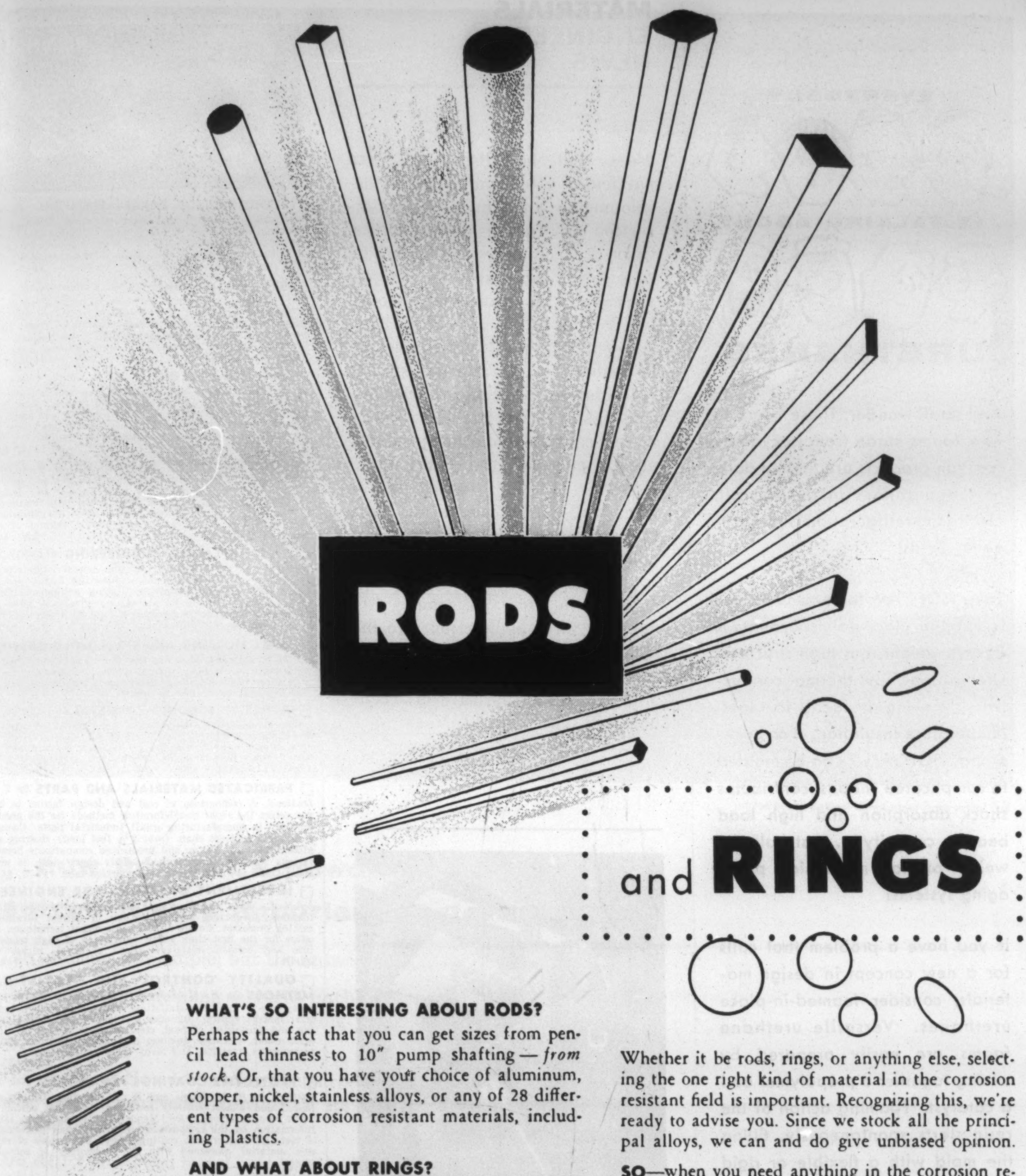
FAST SERVICE

POLYETHYLENE
Drum & Container
LINERS • BAGS
SPECIAL PROTECTORS
Printed • Plain
Perforated • Compound
Complex Shapes
TO YOUR SPECIFICATIONS

SOCIETY OF THE PLASTICS INDUSTRY
SPI

CRYSTAL-X
Corporation
119 W. Lenni Road
Lenni Mills 9, Penna.
In Delaware Valley, U. S. A.
Phone: Valleybrook 2700

For more information, Circle No. 434



WHAT'S SO INTERESTING ABOUT RODS?

Perhaps the fact that you can get sizes from pencil lead thinness to 10" pump shafting — *from stock*. Or, that you have your choice of aluminum, copper, nickel, stainless alloys, or any of 28 different types of corrosion resistant materials, including plastics.

AND WHAT ABOUT RINGS?

Consider EASY-FLO and SIL-FOS — the original and standard low temperature silver brazing alloys. Usually stocked in coils and straight lengths, in ring form, or other special shapes, they can mean substantial savings in production time and costs. We ship them ready for use.

Whether it be rods, rings, or anything else, selecting the one right kind of material in the corrosion resistant field is important. Recognizing this, we're ready to advise you. Since we stock all the principal alloys, we can and do give unbiased opinion.

SO—when you need anything in the corrosion resistant line, think of Whitehead. Seven conveniently located warehouses with more than 20,000 items to choose from — products of such leading producers as Alcoa, Inco, Anaconda, Handy & Harman and many others. You'll find it will pay to Call WHITEHEAD First.

ALUMINUM • BRASS • BRONZE • CLAD METALS • COPPER • MONEL • NICKEL • INCONEL • PRIMARY NICKEL & FERRO ALLOYS • PLASTICS • STAINLESS STEEL

SHEET • ROD • WIRE-SHAPES • PIPE • TUBE • VALVES • FITTINGS • FASTENERS • WIRE MESH • WELDING AND BRAZING MATERIALS

WHITEHEAD
METAL PRODUCTS COMPANY, INC.

303 West 10th Street • New York 14, N.Y.
Other Offices and Warehouses:
PHILADELPHIA • BUFFALO • HARRISON, N. J.
CAMBRIDGE, MASS. • SYRACUSE • BALTIMORE

For more information, turn to Reader Service Card, Circle No. 542

EVERYBODY

IS TALKING ABOUT

URETHANES

And small wonder. These amazing new foams made from isocyanate reaction products are finding daily new applications in the aircraft, electronic, refrigeration and packaging fields.

Take ISOFOAM for example. This foamed-in-place polyisocyanate is light in weight, has high structural strength and low thermal conductivity, making it ideal for low-temperature insulation. For packaging, ISOFOAM-F can be molded to complicated shapes, contributes shock absorption and high load bearing capacity . . . at half the weight of most mechanical packaging systems!

If you have a problem that calls for a new concept in design materials, consider foamed-in-place urethanes. Versatile urethane foams are easily prepared by mixing together a prepolymer and a catalyst. Foaming action of the resin starts spontaneously, filling the mold with a flexible or rigid foam as desired. Foamed-in-place urethanes are easy to handle, eliminate cutting waste, reduce labor costs to a minimum.

Write today for complete details or contact the representative in your area:

Loven Chemical of California, Newhall, Cal.
Application Engineers, Inc., Englewood, Colo.
J. J. Huebner Co., Box 3703, Detroit, Mich.

ISOCYANATE PRODUCTS, INC.
Wilmington 99, Delaware

For more information, Circle No. 515

MATERIALS ENGINEERING NEWS

esses will be discussed, with particular attention to recent developments and the probable direction of future developments. Current technology will also be considered, especially the controls required and problems encountered in practice.

Forming operations applicable to electrical ceramics, special refractories, ferrites, abrasives, coatings, ferro-electrics, white wares, cermets and other products are a part of the curriculum. However, these forming operations will be considered as unit processes rather than as the technology of particular products.

Tuition is $200, payable upon notification of admission. Requests for application forms should be made through Office of the Summer Session, Room 7-103, Massachusetts Institute of Technology, Cambridge 39, Mass.

(More News on p 272)

Convair Div., General Dynamics Corp.

Heavy press forgings Eight parts for Convair's delta-wing F-102A supersonic intereeptor are made from heavy press forgings. The fuselage forgings shown here are interchangeable, right with left half, and require only one set of dies. Early F-102A's used "blocker" forgings. Cost of new dies was offset by machining savings on the first few airplanes. Forgings are made for Convair by Wyman-Gordon Co. and Aluminum Co. of America.

REINHOLD BOOKS

LET'S LOOK IT UP

☐ **HANDBOOK OF BARREL FINISHING** *by Ralph F. Enyedy.* Covers every phase of barrel finishing from cleaning and deslugging to coloring, polishing and burnishing in step-by-step sequence. More than 150 complete specification sheets provide all the information necessary for finishing a large variety of parts. 1955, $7.50

☐ **BRAZING MANUAL** *by the Committee on Brazing and Soldering, American Welding Society.* Describes the principles, equipment and procedures involved in the 8 major brazing processes; each operation from surface preparation to postbraze inspection; and techniques of brazing aluminum, magnesium, copper, steels, nickel and many other metals. 1955, $4.75

☐ **PLASTICS TOOLING** *by M. R. Riley.* Summarizes all the information, both published and unpublished, concerning the use of plastics in jigs and fixtures, metal forming dies, plastics-forming molds, die models and prototypes. Describes tools now made of plastics, resins used, how they are made, how long they last, what they cost, etc. 1955, $2.50

☐ **TOOL ENGINEERS' DATA BOOK** *by G. J. Gruen.* Contains all of the tables, formulas, constants and specifications needed by the practicing tool engineer and designer. Contains amazingly complete data on the heat treatment of special alloys and stainless steels, spot identification of metals, alloys and plastics, and a vast amount of other hard-to-find information. 1953, $5.50

☐ **ELECTROPLATING ENGINEERING HANDBOOK** *edited by A. K. Graham.* Brings you newest information on processing techniques and the engineering factors involved in constructing and installing plating equipment. Covers the design of parts to be plated, specifications, processing sequences, testing, maintenance, waste treatment, and much, much more. 1955, $10.00

☐ **SHELL MOLDING AND SHELL MOLD CASTINGS** *by T. C. DuMond.* Explains how the process works and the advantages to be obtained from shell mold castings. Invaluable to everyone who must determine when, where, and how such castings might best be used. 1954, $2.00

☐ **ADHESIVE BONDING OF METALS** *by George Epstein.* Shows how to determine if an adhesive-bonded joint would be advantageous, what type of adhesive to select, how to employ it, and how to design the joint for best performance. Covers the chemistry, formulation, and factors affecting the strength of adhesive bonds. 1954, $2.95

☐ **FABRICATED MATERIALS AND PARTS** *by T. C. DuMond.* A comparison of cost and design factors to help you select the *right* metal-forming methods for the greatest economy in manufacturing small industrial parts. Contains a valuable fold-out chart (over 2½ feet long) showing at a glance the cost, design and production comparisons between various manufacturing methods. This chart alone is worth many times the book's cost to production men. 1953, $6.50

☐ **INVESTMENT CASTINGS FOR ENGINEERS** *by R. L. Wood and D. Von Ludwig.* Describes the salient features, advantages and limitations of current investment casting processes. Covers all the most recent techniques, and offers for the first time a full tabulation of high temperature and corrosion-resistant alloys of steel, nickel and cobalt. 1952, $10.00

☐ **QUALITY CONTROL AND STATISTICAL METHODS** *by E. M. Schrock.* Explains the step-by-step operations of applying statistical methods to modern industrial quality control. Includes problems found in the growing and packaging of food, steel products, errors in filing, mail orders, clothing, lumber, controlling overtime, optical instruments, textiles, and many other applications. 1950, $5.00

☐ **PROTECTIVE COATINGS FOR METALS.** *New 2nd Edition, by R. M. Burns and W. W. Bradley.* Greatly enlarged and almost entirely rewritten, this new edition of Burns' world-famous ACS Monograph contains the latest information on the composition, properties and performance of metallic and organic coatings. Over 640 pages of valuable material concerned with the technology of corrosion control. 1955, $12.00

☐ **TITANIUM AND TITANIUM ALLOYS** *by J. L. Everhart.* Summarizes and coordinates the extensive periodical literature which has appeared since titanium became of commercial significance. Emphasizes the properties, fabrication, machining and applications of commercial titanium and those alloys now in production. 1954, $2.95

FREE EXAMINATION

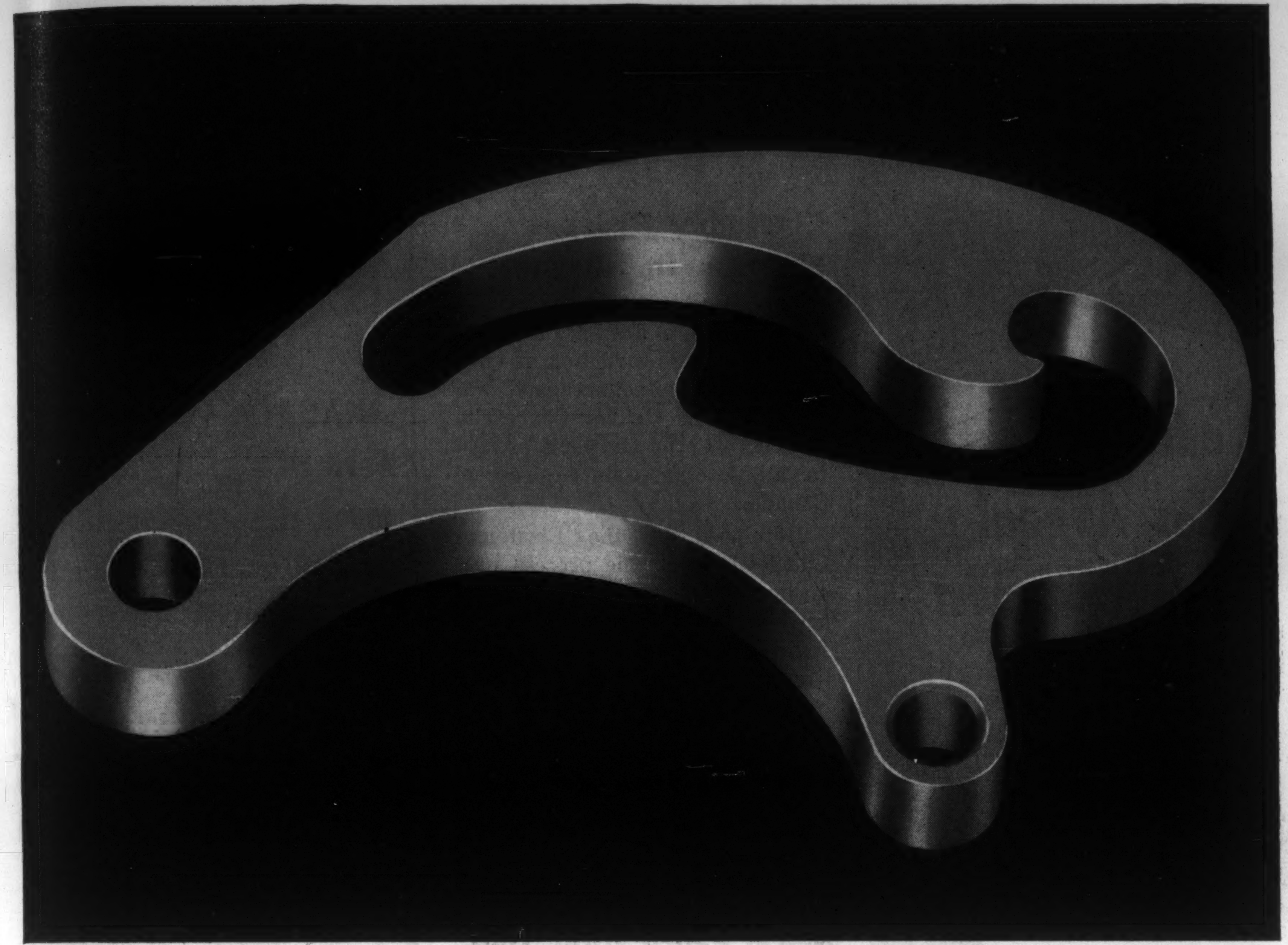
REINHOLD PUBLISHING CORPORATION
Dept. M-949, 430 Park Ave., New York 22, N. Y.

Please send me the books checked above for 10 days FREE EXAMINATION.

NAME____________________
(Please Print)

ADDRESS____________________

For more information, Circle No. 526



ratchet for file cabinet shown about twice actual size

how this YALE powdered metal part solved a very important cost problem:

The problem was simple, but the answer wasn't.

The company made filing cabinets. Each drawer used two of the parts shown above. And thousands of filing cabinets meant hundreds of thousands of these parts.

The problem: How to produce the part—with the extra strength and close tolerances needed because of its unusual shape—without its cost becoming prohibitive.

A YALE* powdered metal part was the happy solution. The irregular shape was no obstacle because of the flexibility of powder metallurgy.

And YALE engineers, working closely with the manufacturer, performed the metallurgical magic that solved the rest of the problems.

Final results? Tensile strength: more than adequate. Cost: appreciably lower than similar machined parts. Performance: better than required. Delivery: on schedule, and in the large quantities necessary.

Perhaps you have a problem a YALE powdered metal part can solve. Our engineers are as close as your telephone whenever you'd like to talk about it.

*REG. U.S. PAT. OFF.

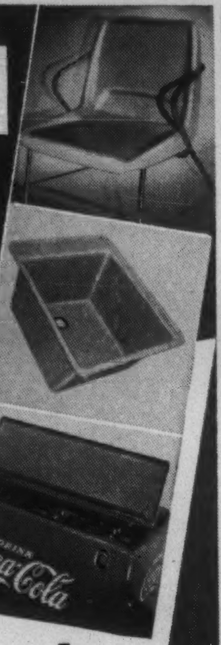
powdered metal parts

YALE & TOWNE

THE YALE & TOWNE MANUFACTURING COMPANY, POWDERED METAL PRODUCTS DIVISION, 9335 BELMONT AVENUE, FRANKLIN PARK, ILLINOIS

For more information, turn to Reader Service Card, Circle No. 521

Molded Fiber Glass

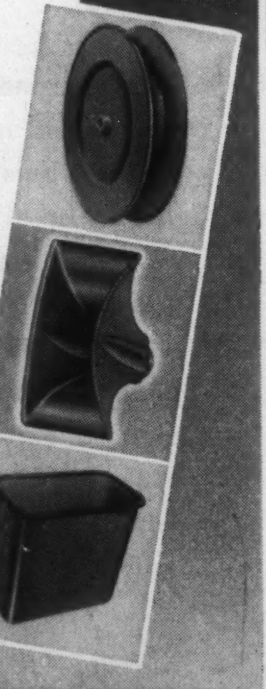


adds *Sales Appeal* to your product

MOLDED FIBER GLASS gives your product a unique combination of selling features that no other material can offer:

- Unusual strength
- Light weight
- Corrosion, rust and weather resistance
- Heat resistance
- Impact resistance
- Dielectric strength
- Molded-in color
- Beauty

Your product, made of MOLDED FIBER GLASS, does the job *better* . . . lasts longer . . . is often more economical to produce. Write for information.



SP

See MOLDED FIBER GLASS products at Booths 715 and 719, Seventh National Plastics Exhibition, New York, June 11-15.

molded Fiber Glass company

THE GREATEST NAME MOLDED FIBER GLASS IN REINFORCED PLASTICS

4421 Benefit Ave.
Ashtabula, Ohio

For more information, Circle No. 489

MATERIALS ENGINEERING NEWS

Elastomer Process Licensed in Europe

Seven European companies have been licensed to use the Elastomer process in the production of vinyl foam. The announcement was made by The Gridler Co., exclusive licenser of the new process in all foreign countries except Canada.

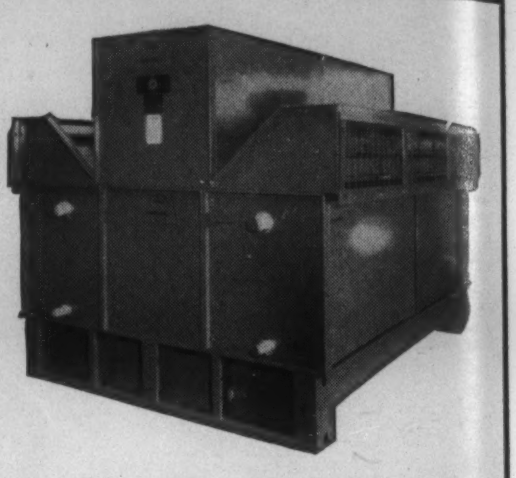
Developed by the Elastomer Chemical Corp., the process uses an inert gas, rather than a chemical blowing agent, to make vinyl foam. Overseas licensees will utilize vinyl foam for upholstery, bedding, backing for natural and synthetic fibers and films, carpet and flooring underlays, insulation and soundproofing.

Four Movies Portray Metal Fabrication, Use

Forging, vacuum melting, steel tubing and corrosion star in industrial motion pictures released during the past month.

A full color and sound movie, entitled, "The Shape of Things," uses the Forging & Casting Plant of Allegheny Ludlum Steel Corp. as its locale. Although the movie is designed for those interested in knowing more about the facilities and operations of the forging plant, such items as forging techniques, special anvil die work, the making of composite die sections, and general and special foundry practices are also covered. Copies of "The Shape of Things" are available for showing on request to the Advertising Dept., Allegheny Ludlum Steel Corp., 2020 Oliver Bldg., Pittsburgh 22, Pa.

Another color film, produced by the Metals Div. of Utica Drop Forge & Tool Corp., traces the complete process of vacuum melting. Beginning at the conference table where the melt content is discussed, the route is traced through test melt to finished ingot. This film may be obtained from



NIAGARA SECTIONAL *Aero* HEAT EXCHANGER gives close temperature control, saves you LABOR, Power, Water

- **Because the new design improves the heat transfer to the out-door air by evaporation.**
- **Because new features keep your equipment working for long life with "new plant" efficiency . . . always full capacity.**
- **Because you save 95% of cooling water cost.**

You get faster, more accurate cooling of industrial fluids to specified temperatures.

You improve your quality of production by removing heat at the rate of input.

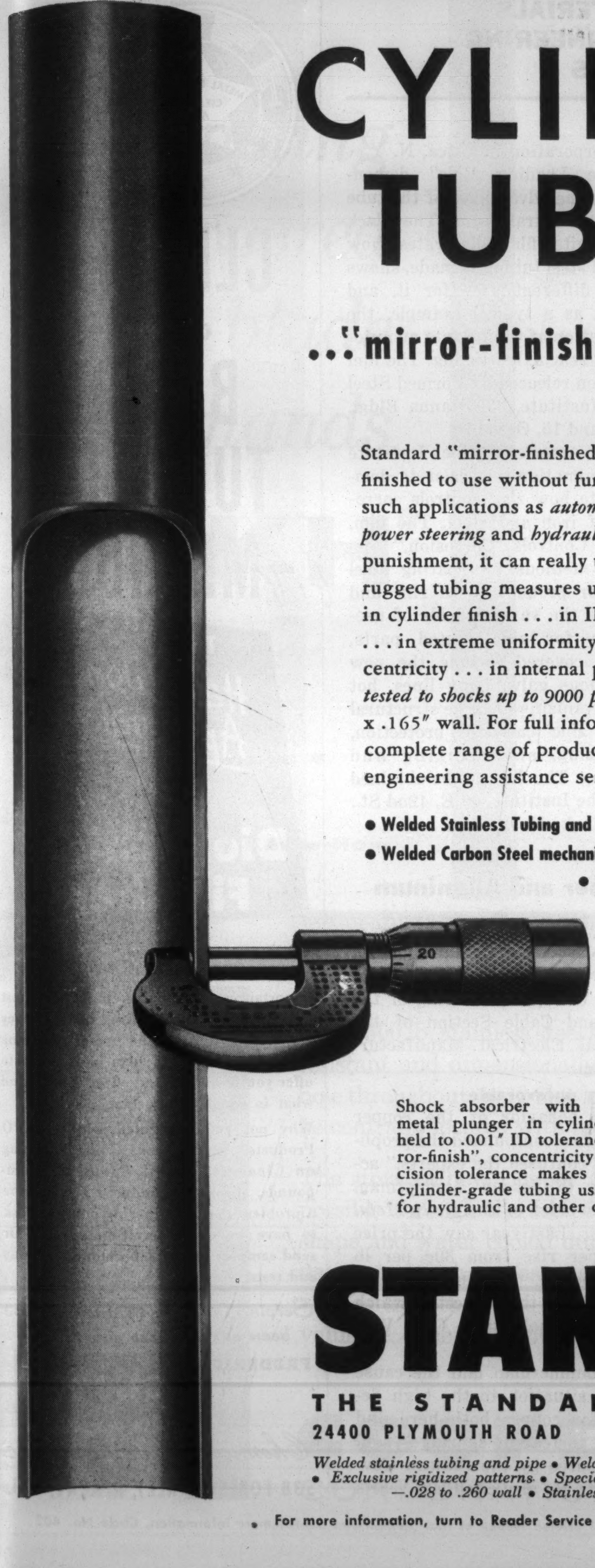
You save labor in upkeep. With full access to all interior parts and piping you see everything in easy inspections. You head off dirt accumulation and corrosion. Casing panels are removable without moving the coils. The coils can be cleaned from both sides.

First cost is low; freight is low because of the lowest space/weight ratio; you save much labor in erection. Capacity range is 7,000,000 to 18,000,000 Btu/hr. No other heat exchange method gives you so much saving in money and convenience.

Write for Niagara Bulletin No. 132

NIAGARA BLOWER COMPANY
Dept. M.M., 405 Lexington Ave.
NEW YORK 17, N. Y.
District Engineers in Principal Cities of U. S. and Canada

For more information, Circle No. 474



CYLINDER TUBING

..."mirror-finished" by Standard

Standard "mirror-finished" cylinder tubing is full-finished to use without further sizing or finishing for such applications as *automobile shock absorbers, power steering* and *hydraulic pumps.* When it comes to punishment, it can really take it. Every inch of this rugged tubing measures up to exacting specifications in cylinder finish . . . in ID tolerances as close as .001″ . . . in extreme uniformity of wall thickness and concentricity . . . in internal pressure resistance, *tested to shocks up to 9000 p.s.i.* Cylinder sizes to 3″ OD x .165″ wall. For full information on Standard's complete range of products, plant facilities and engineering assistance send for *free* folder below.

- **Welded Stainless Tubing and Pipe.**
- **Welded Carbon Steel mechanical.**
- **Boiler and Heat Exchanger.**
- **Exclusive rigidized pattern.**
- **Special Shapes**

Shock absorber with metal-to-metal plunger in cylinder tube held to .001″ ID tolerance. "Mirror-finish", concentricity and precision tolerance makes Standard cylinder-grade tubing usable *as is* for hydraulic and other cylinders.

Standard
WELDED TUBING

Free 8-page folder on all Standard products. Write to address below.

STANDARD

THE STANDARD TUBE COMPANY

24400 PLYMOUTH ROAD • DETROIT 39, MICHIGAN

Welded stainless tubing and pipe • Welded carbon steel mechanical • Boiler and Heat Exchanger • Exclusive rigidized patterns • Special Shapes • Steel Tubing—Sizes: ½″ OD to 5½″ OD —.028 to .260 wall • Stainless—Sizes: ¼″ OD to 4″ OD—.020 to .154 wall.

For more information, turn to Reader Service Card, Circle No. 518

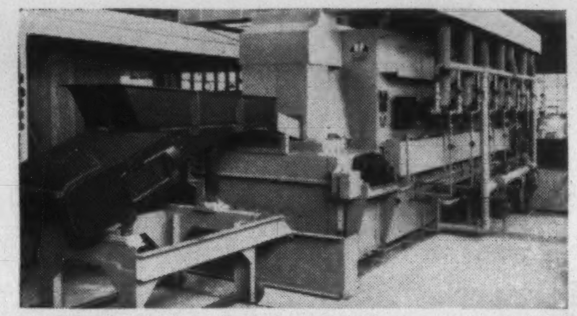
EF FURNACES

For Carbonitriding

Carbon Correction

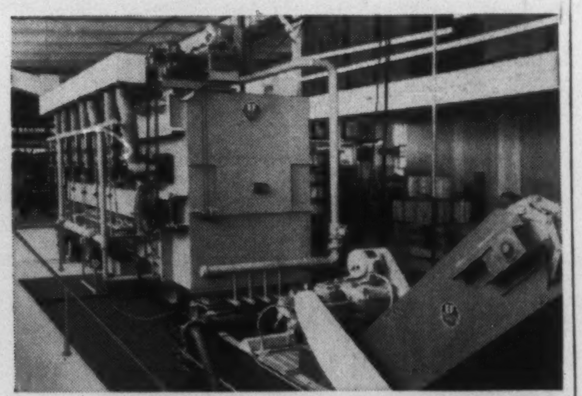
Carburizing

**Non-Decarb, Scale-Free
Hardening and other Processes
175 to 2000 lbs. per hour**



EF Gas Fired Radiant Tube Combination Hardening and Dry Cyaniding Unit Fitted with an Automatic Feeder that Distributes the Parts Evenly on the Chain Belt Conveyor; and a Dual Quench.

The EF chain belt conveyor furnace is one of the most satisfactory continuous heating units yet devised for treating small and medium size parts. The material is loaded onto cast link conveyor belt; carried through the furnace; heated uniformly to proper temperature; automatically quenched and discharged. No pans or trays are needed. Hundreds in daily operation prove the dependability and efficiency of our design. Gas, oil or electrically heated. Furnished complete with any desired feeding, discharging or special atmosphere equipment.



The Conveyorized, Partitioned Dual Quench Moves Laterally to Permit either the Complete Oil or the Water Quenching Equipment to be Positioned under the Sealed Furnace Discharge.

BULLETIN No. 461
shows typical installations
of EF Gas-fired, Oil-fired
and Electric Furnaces
Send for a copy today!

THE ELECTRIC FURNACE CO.
Salem - Ohio
GAS-FIRED, OIL-FIRED AND ELECTRIC FURNACES
FOR ANY PROCESS, PRODUCT OR PRODUCTION

Canadian Associates
CANEFCO LIMITED • Toronto 1, Canada

MATERIALS ENGINEERING NEWS

the Corporation in Utica, N. Y.

"The Leading Role" demonstrates the advantages of the tube as a structural form. The black and white film illustrates how welded steel tubing is made, shows many different uses for it, and shows, as a typical example, the fabrication of tubing into an automobile rear axle housing. The film has been released by Formed Steel Tube Institute, 850 Hanna Bldg., Cleveland 15, Ohio.

The American Zinc Institute uses animation and color to demonstrate how zinc controls corrosion of iron and steel. The film, "Zinc Controls Corrosion," explains methods for coating steel stock or products with zinc and surveys the various fields of usefulness for zinc coated parts. Topics covered include the new continuous galvanizing lines, hot dip galvanizing of large structural parts, zinc cathodic protection, metallizing, sherardizing and painting. The film can be obtained from the Institute, 60 E. 42nd St., New York, N. Y.

Copper and Aluminum Situations Compared

Copper and aluminum figured prominently in discussions held during the spring meeting of the Wire and Cable Section of the National Electrical Manufacturers Assn.

Copper: unfavorable

"The behavior of the copper market has confounded the prophets and confused the experts," according to Joseph Zimmerman, editor-in-chief of the *Daily Metal Reporter*. Last year saw the price of copper rise from 30¢ per lb to 43¢ per lb. The present price, 46¢ per lb, is the highest at which copper has sold since Civil War days.

Dr. Zimmerman laid the cause of this situation to the high demand for copper both here and abroad, to fear of shortages, and to pressures by the Chilean Government. He also cited last year's

CLEPO
METAL FINISHING
CLEANERS
AND
PROCESSES

CLEANERS
and
BARREL TUMBLING METHODS
THAT
Have Won Approval
of
Die Casting Finishers

Cleaning and barrel tumbling are important operational steps. They must rank high in your thinking because they are so important in the overall finishing picture. CLEPO Products have much to offer you in quality and effectiveness; and what is equally important, economy.

Why not get acquainted with CLEPO Products? Send for our General Catalog on Cleaners, Barrel Tumbling Compounds, and other products. If you have a problem that is bothering you now, ask to have our field service man call. Or send samples to our laboratory for study and tests.

Serving industry in this way has been our business since 1933

FREDERICK GUMM
Chemical Company Inc.
538 FOREST STREET, KEARNY, N.J.

For more information, Circle No. 402

Casting cored Sigma blade demands AKH*

** Advanced Know-How*

This 1500 lb. stainless steel sigma blade not only has to be corrosion resistant and dimensionally accurate, but it requires a 1½″ cored hole throughout its 12 foot length . . . and what's more the hole must be centrally located with respect to the various cross sections.

The story of how Cooper Alloy Advanced Know-How made this possible through the use of stainless steel pipe bent to the proper shape and water cooled during pouring is told in AKH#4. If you design or purchase cast stainless components you will find this, as well as the other case histories in this series, both interesting and valuable. A note on your letterhead will bring them by return mail.

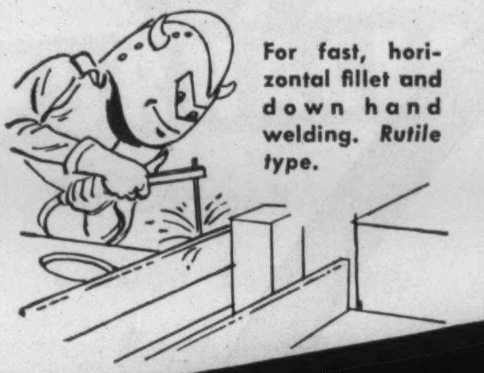
Foundry Products Division

COOPER ALLOY
CORPORATION • HILLSIDE, N.J.

For more information, turn to Reader Service Card, Circle No. 534

NO. 12

For fast, horizontal fillet and down hand welding. *Rutile type.*



NO. 14

For fast, all position welding. *Rutile type.*

For CHAMPION RESULTS Choose these IRON POWDER SPEEDEMON ELECTRODES

■ Champion Speedemon iron powder electrodes are carefully compounded to insure uniform quality weld deposits. These electrodes offer very high deposition rates with minimum spatter loss and extremely easy slag removal. They offer extreme ease of handling. *Full information is available upon letterhead request to Dept.* M.

NO. 716

For fast, high quality any position welds on hard to weld steels. *Low hydrogen type.*

NO. 716-MO

For fast, all position welding on 70,000 P.S.I. steels. Low hydrogen .5% *Moly type.*

CATALOG ON REQUEST
Descriptive of Full Line

THE CHAMPION
RIVET COMPANY
CLEVELAND 5, OHIO
EAST CHICAGO, INDIANA

For more information, turn to Reader Service Card, Circle No. 478

MATERIALS ENGINEERING NEWS

crippling strikes in Northern Rhodesia, Chile and the United States that caused a loss in production of about 160,000 tons.

The present price confusion in copper is greater and more serious than it has ever been before, Dr. Zimmerman observed. Copper producers themselves are not particularly happy with the high price and some have been trying to bring the price back to what they regard a reasonable level. They may succeed in doing this if there are no strikes in the copper producing industry this year, he concluded.

Aluminum: favorable

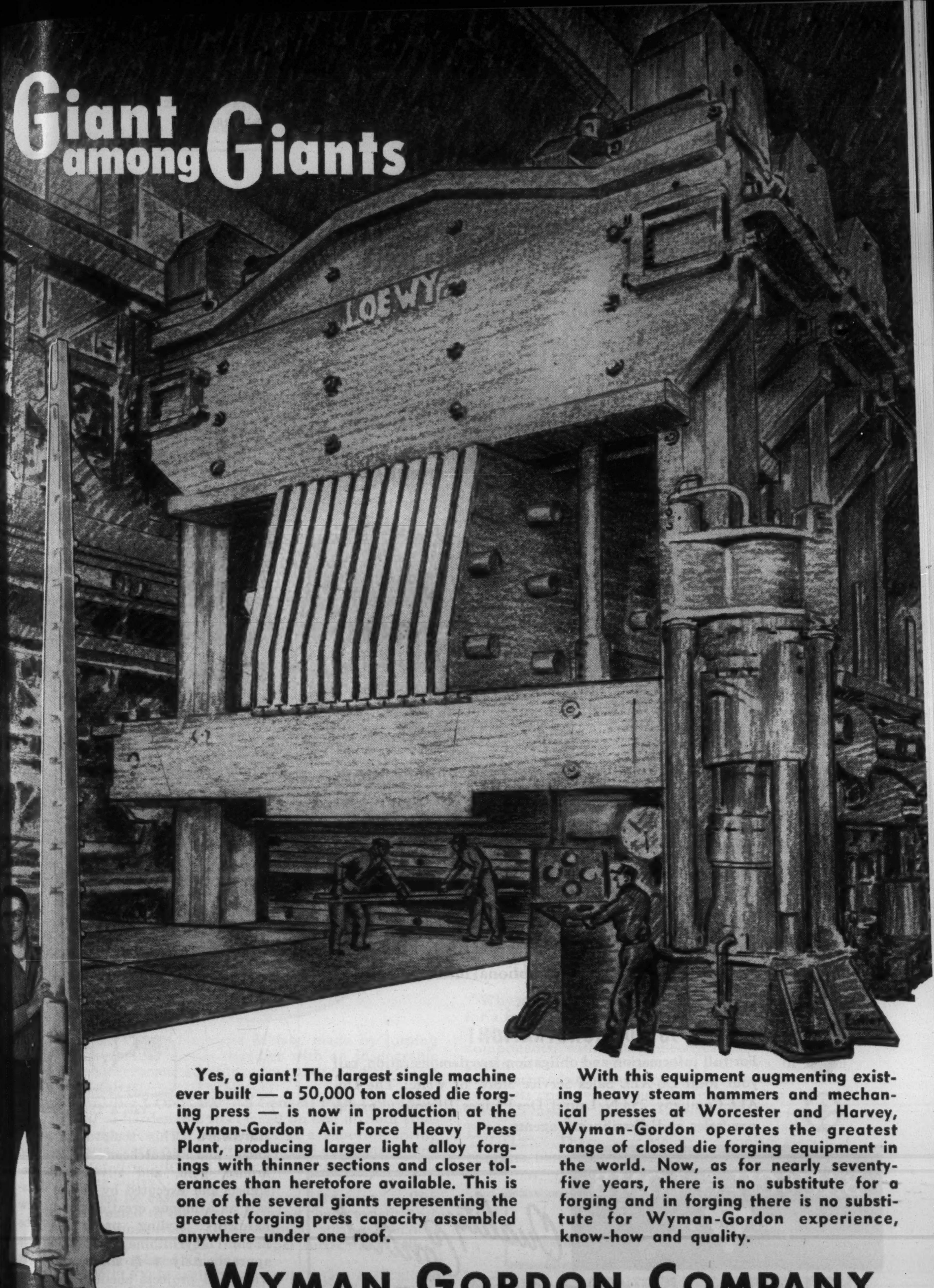
By 1960 the amount of aluminum used in electrical applications will be almost 60% greater than in 1955. This was the forecast of Irving Lipkowitz, assistant to the president of Reynolds Metals Co. The gain, he said, would total 350,000 tons and would represent an increase of 162% over the amount of aluminum used in electrical applications in 1950.

Mr. Lipkowitz said that the total aluminum supply had increased 87% during the past five years. Even more important, the supply outlook far into the future is brighter for aluminum than for copper. The known economic reserves of aluminum ore are much larger and of a higher grade than those of copper ore. Also, aluminum ores now being used are 29 times as rich in metal content as the copper ores.

While the supply of aluminum has steadily increased, its price has undergone a revolution in the past 15 years. Just before World War II, the base price per pound of aluminum was 80% higher than that of copper. Today, aluminum is 48% lower in price than copper on a per pound basis. On a use basis, with one pound of aluminum doing the electrical work of two pounds of copper, aluminum is 74% lower in price than an equivalent amount of copper.

(More News on p 278)

For more information, Circle No. 545 ➤



Yes, a giant! The largest single machine ever built — a 50,000 ton closed die forging press — is now in production at the Wyman-Gordon Air Force Heavy Press Plant, producing larger light alloy forgings with thinner sections and closer tolerances than heretofore available. This is one of the several giants representing the greatest forging press capacity assembled anywhere under one roof.

With this equipment augmenting existing heavy steam hammers and mechanical presses at Worcester and Harvey, Wyman-Gordon operates the greatest range of closed die forging equipment in the world. Now, as for nearly seventy-five years, there is no substitute for a forging and in forging there is no substitute for Wyman-Gordon experience, know-how and quality.

WYMAN-GORDON COMPANY

Established 1883

FORGINGS OF ALUMINUM • MAGNESIUM • STEEL • TITANIUM
WORCESTER 1, MASSACHUSETTS
HARVEY, ILLINOIS DETROIT, MICHIGAN

Bausch & Lomb
BENCH COMPARATOR

So easy, inexperienced help become
SKILLED INSPECTORS
in a single afternoon!

Speed production of precision parts with this simple, time-saving *optical* inspection tool. No complex set-ups, no holding fixtures needed for most work. With exclusive under-stage illumination you simply lay work on table—see accurately magnified silhouette at comfortable eye level. Performs equivalent of several different mechanical inspections in one quick, easy visual check. Instantly reveals costly production errors. Reads to .0001″ with optional micrometer stage.

SEE FOR YOURSELF IN ON-THE-JOB DEMONSTRATION!

For full information and obligation-free demonstration, call your local Do-ALL Sales Service Store, or write: The Do-ALL Company, 254 N. Laurel, Des Plaines, Illinois . . . exclusive sales and distribution agents.

BAUSCH & LOMB
SINCE B&L 1853

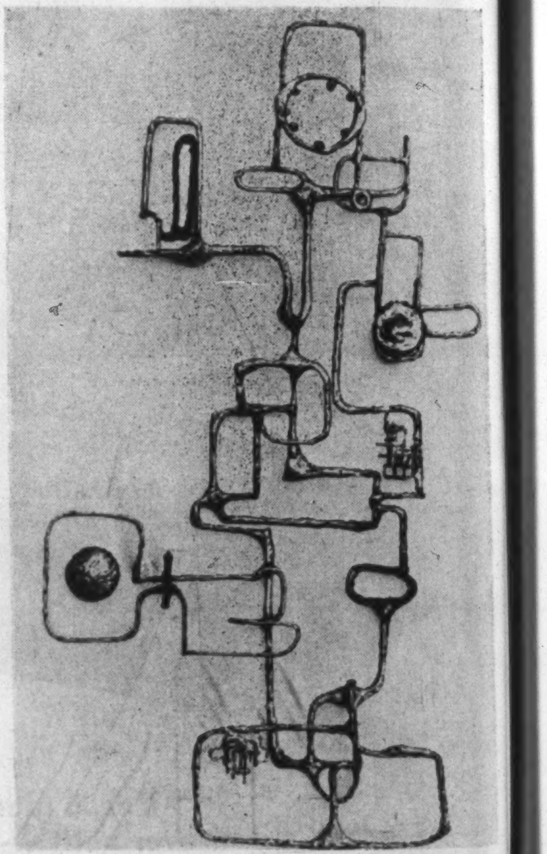
Quality Control
INSTRUMENTS

MATERIALS ENGINEERING NEWS

Investment Casting Is Subject of Course

The Investment Casting Institute will sponsor a six-day intensive course in investment casting at the University of Michigan Sep 10 to 15.

The course will consist of both lectures and laboratory experiments, and will be divided into six parts: investment materials; gating and risering (mold design); melting, refining and degassing; properties of heat resistant alloys; new techniques and developments; and a seminar on precision casting methods, methods of instrumentation, furnace design, furnace atmospheres and desirable thermal cycles.



Yale & Towne Mfg. Co.

Hardware This sculptured silver knob and escutcheon in welded bronze, gold, and silver was designed and executed by Ibram Lassaw as a unique creation for a new hardware styling program. The linear labyrinthine decoration is approximately 4 ft high and 2 ft wide, and projects about 3 in. from the flat plane of the door.

Two Metals
are often
Better Than One
COPPER
HARDENABLE STEEL
COPPER

...and General Plate
CONFLEX*
is a case in point

General Plate Composite Metals, made by joining two dissimilar metals together with an inseparable bond, offer many advantages not always possible in a single metal.

Consider CONFLEX — a General Plate Composite Metal of hardenable steel faced on one or both sides with sheet copper. CONFLEX is a superior spring material, yet it offers better electrical conductivity and greater strength — at lower cost — than comparable copper alloys.

It can be easily formed before hardening — then heat treated to the desired spring characteristic with greater uniformity. In mechanical springs, such as pen and pencil clips, the copper surface is excellent for electroplated finishes.

CONFLEX is available in long length coils slit to desired widths for automatic machine feeding. All in all it offers many advantages in the manufacture of electrical and mechanical spring parts.

Why not get acquainted with CONFLEX by sending for a free sample today?

If you are looking for stronger or lighter metal components, with better electrical and mechanical properties and fewer corrosion problems, or if you are interested in conserving critical metals or reducing parts costs, you should be investigating General Plate Composite Metals. Catalog PR-700 covering precious to base and base to base cladments, TRUFLEX® Thermostat Metals, composite electrical contacts, buttons and rivets, etc. sent free. Write for it!

*Trade Mark of Metals & Controls Corporation

You can profit by using General Plate Composite Metals!

METALS & CONTROLS CORPORATION
GENERAL PLATE DIVISION
66 FOREST STREET, ATTLEBORO, MASSACHUSETTS

* For more information, turn to Reader Service Card, Circle No. 494

molded Brush Holders

Now Available MOLDED NYLON as well as Phenolic

supplied from stock to help motor makers build better motors

EXTERNAL THREAD?
with insert molded in

INTERNAL THREAD?
with insert molded in

MOLDED THREADS?
on holders and caps

BRUSH CAPS TO FIT?
Internal or External Thread
Many Stock Sizes

MOLDED COMMUTATORS?
with or without prongs
or segmented
Complete Range of Stock Sizes

Send Blueprint for Quotation

Midwest Molding
AND MANUFACTURING COMPANY
GURNEE 94 ILLINOIS

Chicago Phone: Dickens 2-0777
Long Distance: ONtario 2-1320

PLASTICS · TOOLING · COMPRESSION · INJECTION

For more information, turn to Reader Service Card, Circle No. 455

LETTERS TO THE EDITOR

Continued from p 14

for the specific application mentioned. The limited tests that have been made indicate that in many respects these steels are comparable to the standard nickel-chromium steels. However, the producers may have later and better data.

Porcelain enamel

To the Editor:

With very great interest I read your report in MATERIALS & METHODS on "What's New in Porcelain Enamel?" My interest is especially in connection with the application of porcelain for coating water-heaters. During my last visit to America I saw the excellent performances of these heaters which in connection with the cathodic protection are indeed a superior way to manufacture corrosion resistant tanks.

As one of my clients in this country is preparing to manufacture glasslined tanks and as we want to use all the experience which has been made in America, I shall be very much indebted to you if you could tell me what company to contact in order to get American frits for coating steel tanks.

R. V. LINDE, Consulting Engineer
Gräfeling bei München
Germany

A list of the leading frit manufacturers in this country has been sent.

Materials problem

To the Editor:

We wonder if you could supply us with the names of suppliers of material and equipment to solve the following problem.

We have a regular No. 18 two conductor parallel cord with plastic insulation. The two leads are to be connected to low temperature electric heating cables with Geon plastic insulation of about the same diameter as is used in the conductor cord. We wish to mold some kind of a plastic button or closure over the joint so as to provide insulation and give a finished appearance to the product.

What we need is the names of suppliers of a suitable molding plastic for such an application; also the names of suppliers of equipment to do the molding.

T. C. RUSSELL
Wrap-On Co.
Chicago, Ill.

From here it sounds as though a room temperature-curing epoxy splicing compound, with its good dielectric characteristics and its high degree of adherence, might turn the trick. Perhaps some of our readers have encountered a similar application and could make more specific suggestions as to both materials and equipment.

Index to Feature Material

Vol. 43, Jan-June 1956

Covers feature articles, New Materials Previews, MATERIALS & METHODS Manuals, Engineering File Facts

ADHESIVES (see WELDING)

ALUMINUM AND ITS ALLOYS
- Aluminized Coating, New—Mar, p 104
- Aluminum Alloy Screw Machine Parts—May, p 122
- Aluminum Chain—June, p 124
- Aluminum Powder Metallurgy Products—Apr, p 106
- Ceramic Mold Castings—Jan, p 100
- Chromium Plate for Aluminum and Titanium—May, p 120
- Forgings in Aircraft Save Weight, Improve Design—Mar, p 106
- Porcelain Enamel, What's New in —Jan, p 92
- Self-Insulated Aluminum Strip and Wire (Preview)—May, p 167
- Wrought Aluminum Alloys (M&M Manual)—Jan, p 109

BRAZING (see WELDING)

CARBON, GRAPHITE (see NONMETALLIC MATERIALS)

CASTINGS, CASTING
- Bronze Shapes, Continuous Cast—Feb, p 108
- Ceramic Mold Steel Castings—Jan, p 100
- Fabricated Metal Parts—Design and Selection Factors (M&M Manual)—Feb, p 121
- Gray Iron, Properties of (File Fact)—Mar, p 141
- Magnesium Alloy Castings, New Nondestructive Test for—Jan, p 98
- Malleable Iron Castings, Redesigning for—June, p 140
- Metal Powder Slip Castings—May, p 132
- Pearlitic Malleable Iron, Thicker Sections Feasible in New (Preview)—Apr, p 159
- Rubber-Modified Alkyd Sealers for Castings—Apr, p 130

CERAMICS, CERMETS
- Boride Parts Resist Molten Zinc—June, p 132
- Boron Nitride—Jan, p 88
- Inorganic Block Insulation (Preview)—Apr, p 163
- Slip Castings, Metal Powder—May, p 132

COATINGS, FINISHES
- Aluminized Coating, New—Mar, p 104
- Chromium Plate for Aluminum and Titanium, New—May, p 120
- Flame-Plated Coatings Where Service Is Severe—Feb, p 100
- Porcelain Enamel, What's New in —Jan, p 92
- Rubber-Modified Alkyd Sealers for Castings—Apr, p 130
- Titanate Coatings, New—June, p 120
- Wrought Aluminum Alloys (M&M Manual)—Jan, p 109

COPPER, BRASS, BRONZE
- Bronze Shapes Continuous Cast—Feb, p 108
- Ceramic Mold Castings—Jan, p 100
- Metal Powder Parts, Large—Apr, p 112

ENGINEERING FILE FACTS
- Brazing, Nomograph Selects Size of Wire for—Jan, p 129
- Forgeable Metals and Forging Design—June, p 161
- Gray Iron, Properties of—Mar, p 141
- Mechanical Felts, Applications and Properties of—Apr, p 155
- Nylon Plastics, Properties of—May, p 161
- Steel Heat Treating Temperatures and Hardness after Treatment—Jan, p 127
- Titanium and Titanium Alloys, Nomographs for Calculating Hot-Air Contamination of Commercial—Feb, p 139
- Tool Steels — Identification and Type Classification—May, p 163

EXTRUSIONS, EXTRUDING
- Fabricated Metal Parts—Design and Selection Factors (M&M Manual)—Feb, p 121

FABRICS, FIBERS
- Asbestos-Reinforced Low Pressure Laminates—Feb, p 103
- Bonded Fabrics—Feb, p 116
- Floor Covering Materials for Heavy Service—Jan, p 85
- Glass Finish for Reinforced Plastics, A Universal—Jan, p 106
- Mechanical Felts, Applications and Properties of (File Fact)—Apr, p 155
- Pressure Sensitive Tapes (M&M Manual)—Mar, p 123

FELT (see FABRICS, FIBERS)

FORGINGS, FORGING
- Aluminum Alloys, Wrought (M&M Manual)—Jan, p 109
- Fabricated Metal Parts—Design and Selection Factors (M&M Manual)— Feb, p 121
- Forgeable Metals and Forging Design (File Fact)—June, p 161
- Forgings in Aircraft Save Weight, Improve Design—Mar, p 107
- Leaded Forging Steels—Jan, p 104

FORMED SHAPES, FORMING
- Aluminum Alloys, Wrought (M&M Manual)—Jan, p 109
- Fabricated Metal Parts—Design and Selection Factors (M&M Manual)—Feb, p 121

GENERAL
- Better Materials Selection, Improve Quality, Reduce Costs through (Special Report)—May, p 135
- Fabricated Metal Parts—Design and Selection Factors (M&M Manual)—Feb, p 121
- Statistical Quality Control, How to Use for Materials Selection—Apr, p 120

GLASS (see NONMETALLIC MATERIALS)

HEAT TREATMENT, HEATING
- Aluminum Alloys, Wrought (M&M Manual)—Jan, p 109
- Steel Heat Treating Temperatures and Hardness after Treatment (File Fact)—Jan, p 127
- Titanium, How to Heat Treat—June, p 126
- Titanium and Titanium Alloys, Nomographs for Calculating Hot-Air Contamination of Commercial (File Fact)—Feb, p 139

IRONS
- Gray Iron, Properties of (File Fact)—Mar, p 141
- Malleable Iron Castings, Redesigning for—June, p 140
- Pearlitic Malleable Iron, Thicker Sections Feasible in New (Preview)—Apr, p 159
- Porcelain Enamel, What's New in —Jan, p 92

MACHINED PARTS, MACHINING
- Aluminum Alloy Screw Machine Parts—May, p 122
- Aluminum Alloys, Wrought (M&M Manual)—Jan, p 109
- Fabricated Metal Parts—Design and Selection Factors (M&M Manual)—Feb, p 121

MAGNESIUM AND ITS ALLOYS
- Magnesium Alloy Castings, New Nondestructive Test for—Jan, p 98
- Magnesium-Thorium Sheet—Mar, p 114

MANUALS, MATERIALS & METHODS
- Fabricated Metal Parts—Design and Selection Factors—Feb, p 121
- Foam Plastics—June, p 143
- Pressure Sensitive Tapes—Mar, p 123
- Stainless Steels, The New—Apr, p 137
- Wrought Aluminum Alloys—Jan, p 109

NONFERROUS METALS, (see also ALUMINUM, COPPER, MAGNESIUM, TITANIUM)
- Ceramic Mold Castings—Jan, p 100
- Flame-Plated Coatings Where Service Is Severe—Feb, p 100
- Forgeable Metals and Forging Design (File Fact)—June, p 161
- Metal Powder Slip Castings—May, p 132
- Scarce Metals, Present and Future Uses of (cesium, gallium, germanium, hafnium, indium, iridium, osmium, palladium, platinum, rhenium, rhodium, ruthenium, tellurium, thallium, thorium)—Jan, p 80

NONMETALLIC MATERIALS (see also CERAMICS, CERMETS, FABRICS, FIBERS, PLASTICS)
- Floor Covering Materials for Heavy Service—Jan, p 85
- Graphite Performs at High Temperatures, How—May, p 126
- Modified Woods—Old and New—Mar, p 110
- Photosensitive Glass, Chemical Machining of—June, p 134
- Pressure Sensitive Tapes (M&M Manual)—Mar, p 123
- Silicone Rubbers Have High Tensile and Tear Strengths (Preview)—Mar, p 149

PLASTICS
- Asbestos-Reinforced Low Pressure Laminates—Feb, p 103
- Bonded Fabrics—Feb, p 116
- Casting Resins Insulate and Protect Electronic Components—Feb, p 90
- Design Data for Plastics, Devel-

Index to Feature Material

continued

oping—Apr, p 132
  Floor Covering Materials for Heavy Service—Jan, p 85
  Foam Plastics (M&M Manual)—June, p 143
  Glass Finish for Reinforced Plastics, A Universal—Jan, p 106
  Nylon Plastics, Properties of (File Fact)—May, p 161
  Plastics Keep a 50-Ton Tank Afloat—May, p 130
  Plastics, Progress in—June, p 112
  Polyamide Resins, Versatile (Preview)—Mar, p 150
  Polyethylenes Fill the Gap, Two New (Preview)—May, p 165
  Polymethylstyrene and Methylstyrene-Acrylonitrile Copolymer (Preview)—Mar, p 145
  Pressure Sensitive Tapes (M&M Manual)—Mar, p 123
  Teflon and Nylon Bearing Materials—Mar, p 100
  Teflon Improved by New Treatment, Bonding Qualities of—Apr, p 118

POWDER METAL PARTS
  Aluminum Powder Metallurgy Products—Apr, p 106
  Fabricated Metal Parts—Design and Selection Factors (M&M Manual)—Feb, p 121
  Large Metal Powder Parts—Apr, p 112

RUBBER (see NONMETALLIC MATERIALS)

STEELS
  Ceramic Mold Steel Castings—Jan, p 100
  Forgeable Metals and Forging Design (File Fact)—June, p 161
  Forgings in Aircraft Save Weight, Improve Design—Mar, p 106
  Leaded Forging Steels—Jan, p 104
  Metal Powder Slip Castings—May, p 132
  Metal Powder Parts, Large—Apr, p 112
  Porcelain Enamel, What's New in—Jan, p 92
  Stainless Steels, Rare Earth—Feb, p 96
  Stainless Steels, The New (M&M Manual)—Apr, p 137
  Stainless vs Titanium for High Speed Aircraft—Apr, p 124
  Steel Heat Treating Temperatures and Hardness after Treatment (File Fact)—Jan, p 127
  Tool Steels—Identification and Type Classification (File Fact)—May, p 163
  Ultra High Strength Steels, Present and Future—Mar, p 94

TESTING, INSPECTION
  Magnesium Alloy Castings, New Nondestructive Test for—Jan, p 98
  Statistical Quality Control, How to Use for Materials Selection—Apr, p 120

TITANIUM
  Chromium Plate for Aluminum and Titanium, New—May, p 120
  Heat Treat Titanium, How to—June, p 126
  Hot-Air Contamination of Commercial Titanium and Titanium Alloys, Nomographs for Calculating (File Fact)—Feb, p 139
  Stainless vs Titanium for High Speed Aircraft—Apr, p 124
  Where Industry Is Using Titanium—May, p 112

TUBING
  Fabricated Metal Parts—Design and Selection Factors (M&M Manual)—Feb, p 121

WELDING, JOINING, ADHESIVES
  Epoxy Adhesives, How High Temperatures Affect—Mar, p 120
  Fabricated Metal Parts—Design and Selection Factors (M&M Manual)—Feb, p 121
  Fastener, An Unusual—May, p 116
  Projection Welding Can Lower Costs, How Designing for—Feb, p 112
  Size of Wire for Brazing, Nomograph Selects (File Fact)—Jan, p 129
  Steel Bolt, 220,000 Psi (Preview)—June, p 165
  Wrought Aluminum Alloys (M&M Manual)—Jan, p 109

WIRE
  Self-Insulated Aluminum Strip and Wire (Preview)—May, p 167

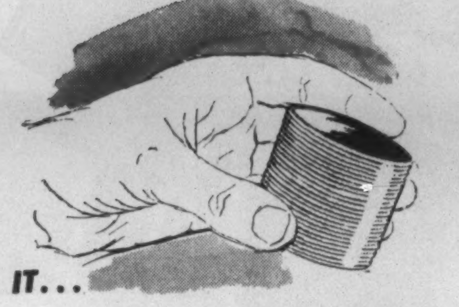
WOOD (see NONMETALLIC MATERIALS)

Author Index

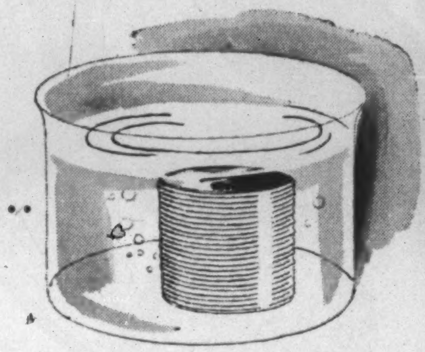
Beaver, H. O., Rare Earth Stainless Steels—Feb, p 96
Brenner, Walter, Foam Plastics (M&M Manual)—June, p 143
Burgston, C. H., How Designing for Projection Welding Can Lower Costs—Feb, p 112
Byer, Marshall, Chemical Machining of Photosensitive Glass—June, p 134
Campbell, John B., An Unusual Fastener—May, p 116
  Asbestos-Reinforced Low Pressure Laminates—Feb, p 103
  Bonded Fabrics—Feb, p 116
  What's New in Porcelain Enamel—Jan, p 92
Campbell, O. L., Rubber-Modified Alkyd Sealers for Castings—Apr, p 130
Caterson, A. G. (see Fraser, G. T.)
Cheney, A. J., Teflon and Nylon Bearing Materials—Mar, p 100
Clauser, H. R., Pressure Sensitive Tapes (M&M Manual)—Mar, p 123
Entenmann, J. R., (see Fulton, D. B.)
Evans, R. M., Boride Parts Resist Molten Zinc—June, p 132
Everhart, John L., Large Metal Powder Parts—Apr, p 112
Fabian, Robert J., New Titanate Coatings—June, p 120
Ferriss, Donald P. (see Hausner, H. H.)
Finlay, Walter L., How to Heat Treat Titanium—June, p 126
  Where Industry Is Using Titanium—May, p 112
Fraser, G. T., Where Industry Is Using Titanium—May, p 112
Fulton, D. B., Redesigning for Malleable Iron Castings—June, p 140
Hall, A. M. (see Roach, D. B.)
Happoldt, W. B. (see Cheney, A. J.)
Hausner, H. H., Metal Powder Slip Castings—May, p 132
Jaffee, R. I. (see Reynolds, J. E.)
Kastelowitz, A. (see Kramer, C. R.)
Kaufmann, D. W. (see Wentz, W. W.)
Kirby, T. J. (see Fulton, D. B.)
Kramer, C. R., Forgings in Aircraft Save Weight, Improve Design—Mar, p 106
Lanphier, B. T. (see Beaver, H. O.)
Levy, Alan V., Thorium-Magnesium Sheet—Mar, p 114
Lewis, Floyd A., Aluminum Alloy Screw Machine Parts—May, p 122
Loch, L. D., How Graphite Performs at High Temperatures—May, p 126
Loucks, H. L., Casting Resins Insulate and Protect Electronic Components—Feb, p 90
Lyle, John P., Jr., Aluminum Powder Metallurgy Products—Apr, p 106
McDonald, J. K., Modified Woods—Old and New—Mar, p 110
McGuiness, E. W., How High Temperatures Affect Epoxy Adhesives—Mar, p 120
Miller, O. O. (see Sands, J. W.)
Multer, R. K., Developing Design Data for Plastics—Apr, p 132
Ogden, H. R. (see Reynolds, J. E.)
Peckner, D., How to Use Statistical Quality Control for Materials Selection—Apr, p 120
Polis, S., Floor Covering Materials for Heavy Service—Jan, p 85
Rayfield, R. H. (see Multer, R. K.)
Reid, H. F., Jr., Aluminum Chain—June, p 124
Reynolds, J. E., Nomographs for Calculating Hot-Air Contamination of Titanium (File Fact)—Feb, p 139
Riley, Malcolm W., Progress in Plastics—June, p 112
  Wrought Aluminum Alloys (M&M Manual)—Jan, p 109
Roach, D. B., The New Stainless Steels (M&M Manual)—Apr, p 137
Rose, Kenneth, Leaded Forging Steels—Jan, p 104
  New Aluminized Coating—Mar, p 104
Sands, J. W., Ultra High Strength Steels, Present and Future—Mar, p 94
Sims, Chester T., Present and Future Uses of Scarce Metals—Jan, p 80
Sloan, R. G., Stainless vs Titanium for High Speed Aircraft—Apr, p 124
Storm, G. D., Continuous Cast Bronze Shapes—Feb, p 108
Strauss, Eric L., A Universal Glass Finish for Reinforced Plastics—Jan, p 106
Swayne, K. G. (see Cheney, A. J.)
Taylor, K. M., Boron Nitride—Jan, p 88
Teter, M. A., Flame-Plated Coatings Where Service Is Severe—Feb, p 100
Topelian, Paul J., New Chromium Plate for Aluminum and Titanium—May, p 120
VanDuzee, G. R., New Nondestructive Test for Magnesium Alloy Castings—Jan, p 98
Vogel, Edward, Ceramic Mold Steel Castings—Jan, p 100
Wentz, W. W., How to Heat Treat Titanium—June, p 126

News about

B.F.Goodrich Chemical *raw materials*

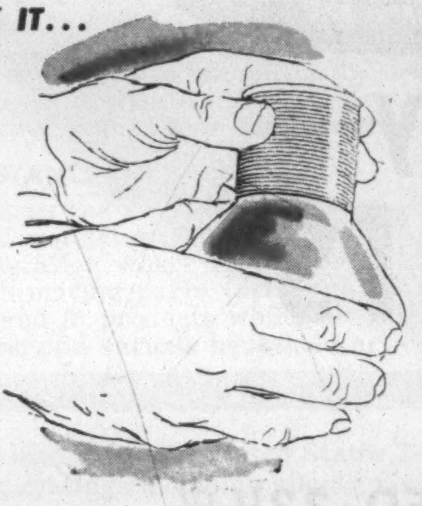


MOLD IT...



DUNK IT...

SHRINK IT...



Unique property of GEON plastics suggests new design applications

THE Geon vinyl plastic collar on this coffee server provides heat insulation and it's highly decorative in its six attractive colors. It is resistant to grease, detergents, acids and abrasion, and it comes through sterilization in autoclaves and dishwashers without damage.

1. **Collars mold accurately and retain their form, when made of Geon.**
2. **Dilated in an acetone solution, they can then be dropped over the neck of the bottle.**
3. **The acetone evaporates, causing the collar to shrink tightly in place.**

This new way to assemble Geon polyvinyl products has already suggested similar uses to other designers. One manufacturer slips protective sleeves on piping until refrigeration units are assembled. Another installs handles on his appliances by this dilate-and-shrink method.

For information on Geon, write Department DP-3, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

A TRADE MARK OF B. F. GOODRICH CHEMICAL COMPANY

Geon

Polyvinyl Materials

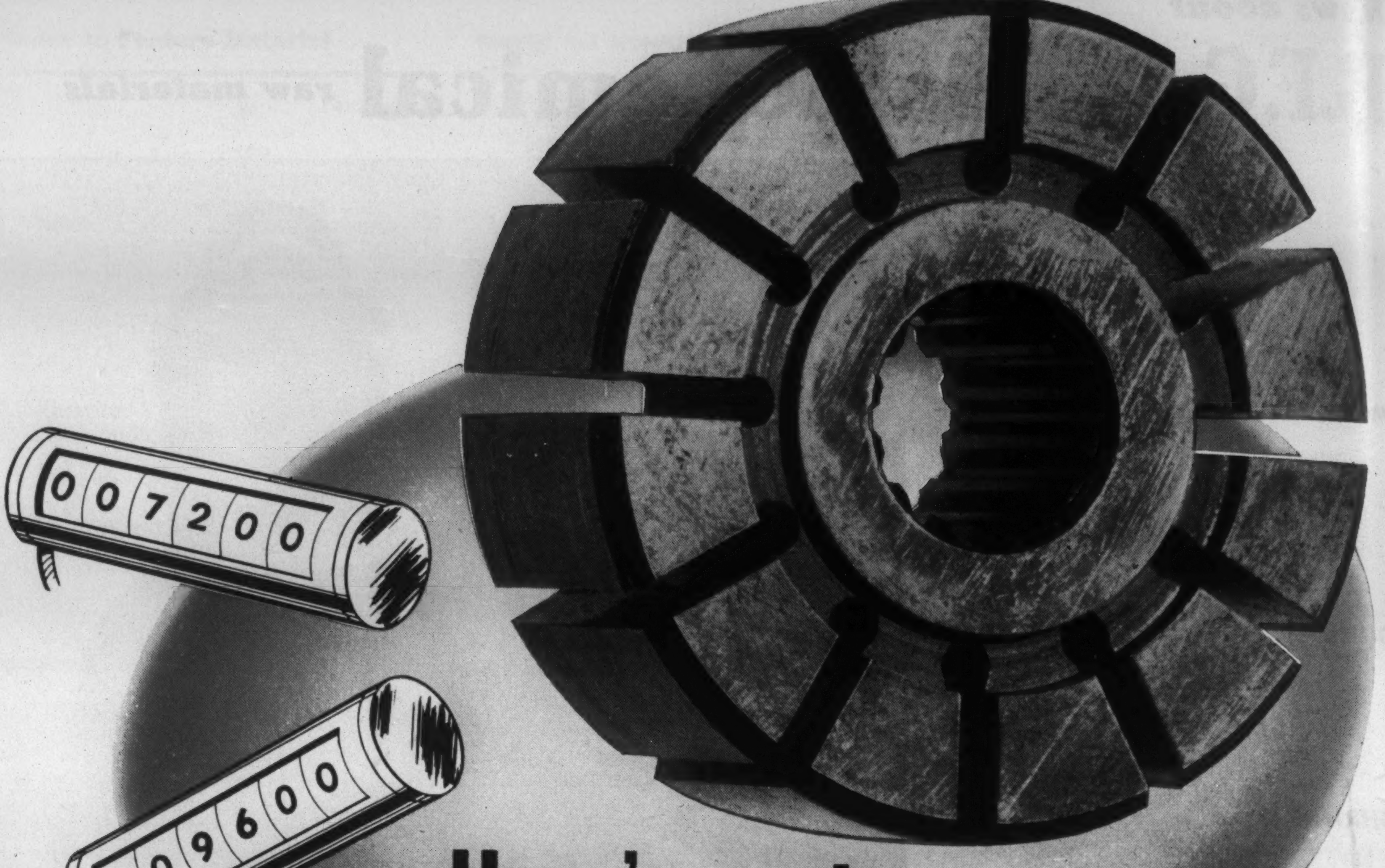
A DIVISION OF THE B. F. GOODRICH COMPANY

Visit us at the Plastics Show! Booths 422-426.

B.F.Goodrich

GEON polyvinyl materials • HYCAR American rubber and latex • GOOD-RITE chemicals and plasticizers • HARMON colors

For more information, turn to Reader Service Card, Circle No. 415



Here's a story that COUNTS

. . . *Tool Life* INCREASED 33⅓% *by using* COPPERWELD 8620 LEADED ALLOY STEEL

A manufacturer of hydraulic pumps was averaging 7200 pieces per set of tools used in milling slots on this hydraulic pump rotor. By switching to Copperweld Leaded Steel, this tool life was increased to 9600 pieces.

In addition to longer tool life, leaded steel gives faster feeds and speeds, and a finer finish often eliminates a clean-up operation—truly, the steel with "built-in productivity." To put more operating profit in your production picture, try Copperweld Leaded Steels.

ARISTOLOY STEELS

Write for free booklet, "Lead Treated Steels."

COPPERWELD STEEL COMPANY • STEEL DIVISION • WARREN, OHIO

EXPORT: Copperweld Steel International Co., 225 Broadway, New York 7, N. Y.

For more information, turn to Reader Service Card, Circle No. 404

you PRE-COATED METAL COIL
or end-use PERFORMANCE
NITED STATES TESTING CO.

RATCH HARDNESS

is test determines how well the coating will withstand ntact with pointed or sharp objects. It covers such condi- ns as the action of sand against awnings at the seashore. rfaces that lack sufficient scratch hardness mar easily, posing the under metal to corrosion after scratching.

CCELERATED WEATHERING TEST

vital test for products in outdoor use, such as lawn furni- re, outdoor play equipment, etc. It exposes the product to e action of light and water over a period of hours to termine its resistance to these elements. Findings are dged against Federal specifications. This test does not nsider the effect of low or high temperatures.

BRASION RESISTANCE

is test determines the resistance of the coating to rub- g or continual contact with another object. This is an portant consideration where the material is to be used r products with moving parts (such as lids, sliding cur- n rods, etc.), and in products which are portable (such flashlight cases, and various household articles).

IMPACT RESISTANCE

A test to determine the resistance of the coating to sudden impact and strain which occur during normal manufacturing operations, as well as in various end-uses. This quality is important in toys, for instance, which usually must withstand abuses such as dropping, kicking, etc. If a coating is too brittle, a sudden impact may cause it to break and flake away from the base metal.

ADHESION

A test to determine the adherence of the coating to the base metal. Adherence must be firm and lasting, so that the coating will not lift away from the metal either during shaping or forming operations, or in consumer use. Long lasting adhesion is important in quality products, (especially those which undergo severe forming operations in manufacture, are subsequently subject to considerable handling, and which may be classified as "permanent" installations such as drapery hardware or air conditioning units).

rformance certified to by the United States Testing Com- ny. All organic coatings including alkyds, vinyls, epoxies, enolics, oleoresinous and many other types of enamels d lacquers are applied. Dry film thicknesses are com- etely and uniformly controllable to within .0001 and are plied in accordance with end-use requirements. *Enamel- rip continuous pre-coated coil may be coated on one or th sides, either with the same or with different types of ishes and/or colors.* Variegated surface effects may be tained by the use of Enamelstrip's newly developed LITHO" finishes.

t us show you how Enamelstrip quality coil can give you better, more economical, more profitable operation and re predictable results than ever before. Our representa- e will call on request.

VINYL LAMINATES

Having pioneered in the development of pre-coated metal coil, Enamelstrip is again leading in the development of organic-clad metal coil. Plastic-metal laminate which can be formed, drawn or stamped is available in a large variety of colors, embossings and as many as four color prints. This new product pioneered by Enamelstrip opens new opportunities for the use of continuous coil in high speed automated production.

The MEANING of
United States Testing Company
CERTIFIED QUALITY

To determine the exact quality of Enamelstrip pre-coated metals, the United States Testing Company took random samples of Enamelstrip production – subjected these samples to impartial tests – and evaluated them on the basis of the following considerations:

1. *The quality of Enamelstrip compared with the quality of competitive products.*
2. *The actual performance of each Enamelstrip metal: on the basis of manufacturer's needs in production, and consumer needs in end-use applications.*

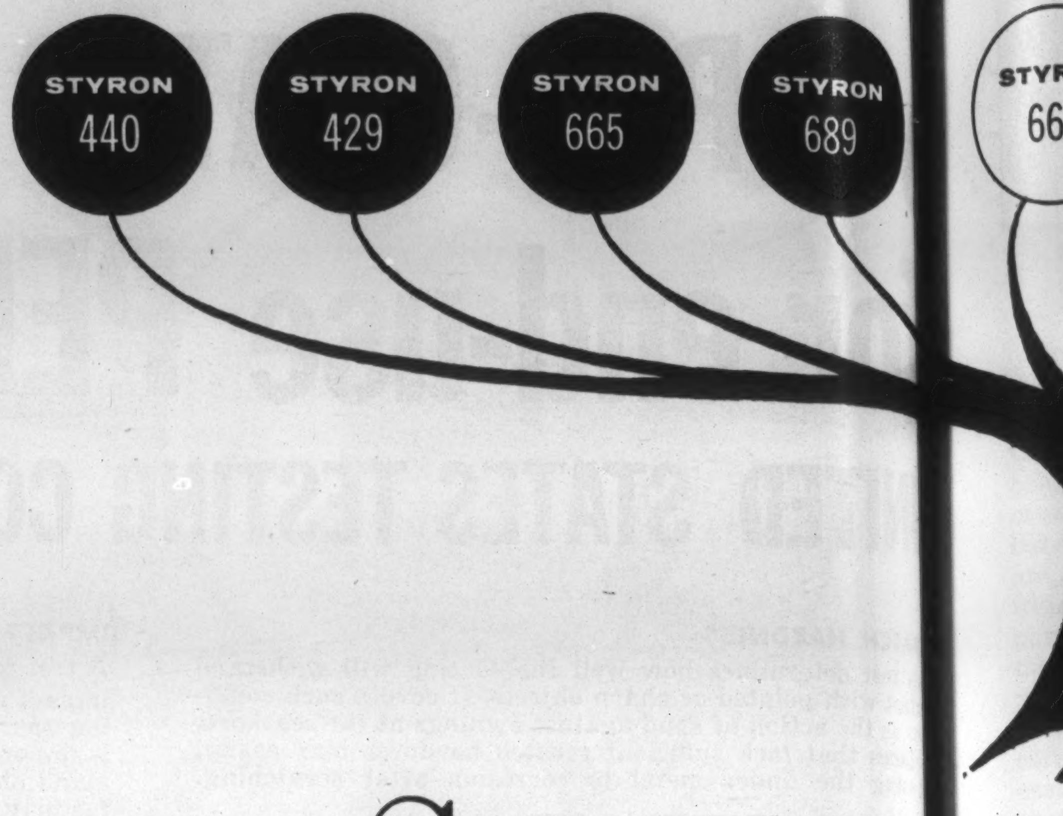
In all cases, the quality of the Enamelstrip pre-coated metals proved to be equal to or better than the competitive products tested. The Enamelstrip metals also were found to satisfactorily meet and in most cases exceed the production requirements of the manufacturer and the end-use requirements of the consumer. On the basis of these findings, the United States Testing Company has granted the Seal of Certified quality to Enamelstrip. The United States Testing Company will continue to check-test Enamelstrip pre-coated coil, as part of Enamelstrip's continuing certified quality control program.

old by **COATED COIL CORPORATION**

505 West 30th Street, New York 1, N. Y. • LOngacre 5-3161

For more information, turn to Reader Service Card, Circle No. 524

Announcing 4 new Styron c



Greater than ever versatility f

STYRON 440

high impact strength with heat distortion of 200° F.

Excellent surface finish. Good moldability. For the first time all these properties are combined in one polystyrene. Long needed for superior radio cabinets, appliance housings, cutlery handles, and parts for refrigerators, cars and cameras.

STYRON 429

high impact strength plus improved surface gloss

Gives greatly improved surface finish and gloss to sheet products. This combination meets the exacting requirements of the industry . . . increased flexural strength brings new benefits to low-cost vacuum forming from thin extruded sheets.

STYRON 665

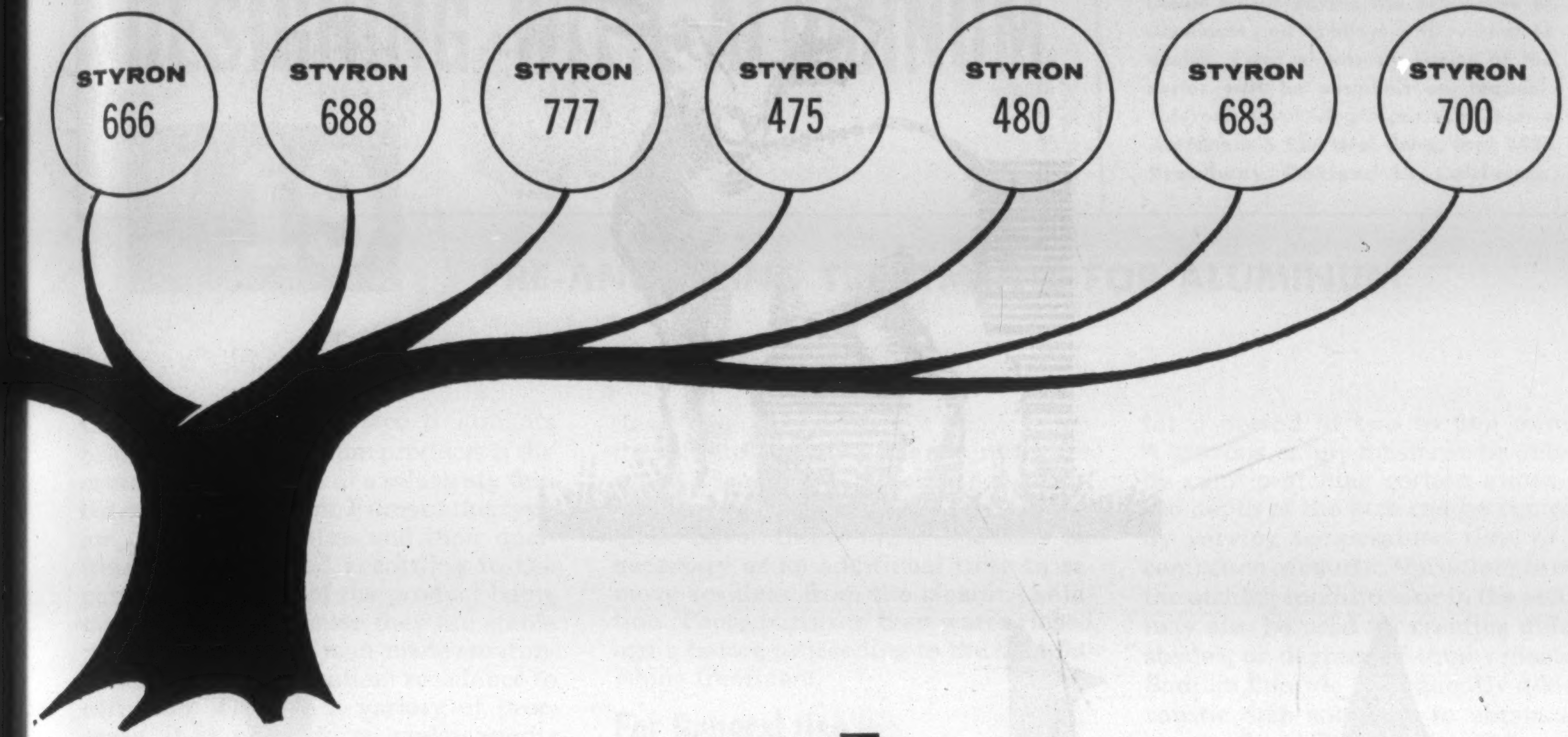
general purpose— for improved extrusion

Provides a new standard for quality performance. Greater resistance to shattering and cracking at the cutoff operation. Relatively high heat distortion temperature. For bristles, thin film and many general shape extrusion applications.

Ma
me
an
di
tai
ex
m

Get full details on the Dow polystyrene family at the Plastic Exposition —Booths 1017 and 1025, Coliseum, New York, June 11-15.

DOW



compounds

for plastics design and molding

STYRON 689

**general purpose—
easy flowing
for thin sections**

Meets the special requirements for molding thin sections, deep draws, and parts demanding accurate dimensional control—such as containers, vials and housewares. Proved excellent for high speed automatic molding and large area parts.

Now the growing family tree of Dow polystyrenes gives you your pick of America's most widely used molded plastics. You have new general purpose Styron® plastic materials with improved flow and extrusion properties. You also have new high impact materials with better heat resistance and glossier surface. As a result, you will find many applications are possible for the first time.

Each new compound has been made to the same high standards of quality and uniformity which have earned for Styron plastics an unparalleled position of leadership. And each formulation is proved to do its job—in laboratories, in fabricating and in use by the consumers. Each is proved to be a real champion in its field.

With the addition of these new compounds, Styron brings you eleven different formulations—more than are offered by any other supplier. It is the first and most complete line of polystyrene ever offered. When you call Dow, you know you will find the right polystyrene to suit every molding need.

Consult your Dow representative. Learn about the extra benefits you get with the complete Dow line of polystyrene. Discover the Dow reputation for service including the unique plastics technical service. Write THE DOW CHEMICAL COMPANY, Midland, Michigan—Plastics Sales Department PL427H.

you can depend on DOW PLASTICS DOW

For more information, turn to Reader Service Card, Circle No. 490

A lamb

brings you so much more than chops!

When you eat a lamb chop, think of the felt in your shoes and slippers, the felt seals in bearings, some of the drugs in your medicine cabinet, soft leather, lanolin-based cosmetics. To us, and to you, the most important by-product of the lamb is wool. About 50% of American's raw material is wool from Texas, South Africa, Australia. In all, there are some 96 grades of wool, some fine as mink, some coarse, like mohair. A sheep grows 13 grades at once; these differ from breed to breed. Buying wool is an art we know well; blending it into felt is a science so carefully controlled that you can specify felt with as much accuracy as any other engineering material, felt for lubrication, vibration absorption, insulation, surgical applications, garments, pads, etc. There is hardly an industry and certainly not a person who does not benefit daily from that by-product of lambs and sheep: wool felt . . . American will gladly collaborate with you in selecting just the right felt for your processes, equipment, or products.

American Felt Company
TRADE MARK ®

GENERAL OFFICES:
24 GLENVILLE ROAD, GLENVILLE, CONN.

SALES OFFICES: New York, Boston, Chicago, Detroit, Cleveland, Rochester, Philadelphia, St. Louis, Atlanta, Greenville, S.C., Dallas, San Francisco, Los Angeles, Portland, San Diego, Seattle, Montreal.—PLANTS: Glenville, Conn.; Franklin, Mass.; Newburgh, N.Y.; Detroit, Mich.; Westerly, R.I.—ENGINEERING AND RESEARCH LABORATORIES: Glenville, Conn.

For more information, turn to Reader Service Card, Circle No. 411

DESIGNING WITH ALUMINUM

NO. 19

This is one of a series of information sheets which discuss the properties of aluminum and its alloys with relation to design. Extra or missing copies of the series will be supplied on request. Address: Advertising Department, Kaiser Aluminum & Chemical Sales, Inc., 1924 Broadway, Oakland 12, California.

PRE-ANODIZING TREATMENTS FOR ALUMINUM

ONE of the many surface treatments being used for aluminum products is the controlled formation of a relatively thin but durable oxide film. Films of this type are called anodic films and their qualities may be varied according to the particular end use of the product being manufactured. Because they are stable in many natural and man-made environments, they offer excellent resistance to corrosion. Through a variety of processes, it is possible to make anodic coatings that offer attractive decorative finishes, that resist abrasion or that act as electrical insulation. Certain anodic finishes are being dyed to create some of the most brilliant colors available in metal products.

Anodic coatings are fairly simple to apply. The process consists of passing an electric current between the metal and an acid solution in which the metal is immersed. However, surface contaminants that are unavoidable during fabrication will affect the coating adversely if they are not removed before anodizing. Oil and metal contaminants picked up by the aluminum surface will cause darkening or streaking of the anodic film and may even inhibit its formation. Therefore simple pre-anodizing treatments are of great importance in obtaining a uniform, continuous anodic film. The choice of the optimum treatment depends upon the ultimate purpose of the anodic coating.

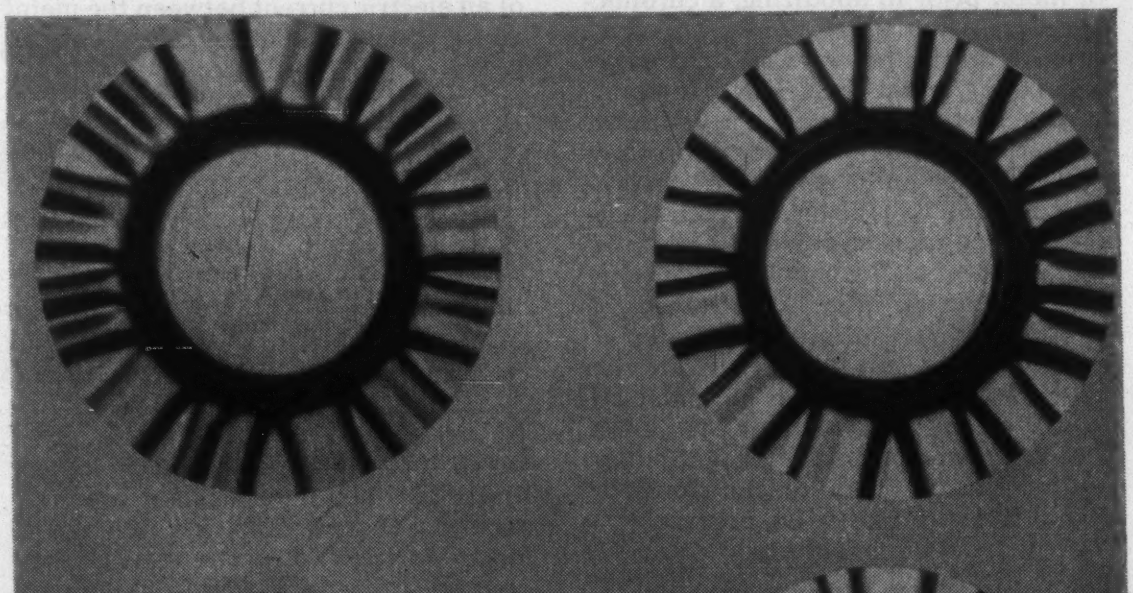
If heavy soil or grease are present, their removal by vapor degreasing or an inhibited alkaline cleaner should be the first step in any pre-anodizing treatment. Both of these cleaning methods are relatively inexpensive, require little handling and may be used to clean inaccessible surfaces thoroughly.

Vapor degreasing may be done by either a batch method or as part of a continuous processing line. The metal to be cleaned is passed vertically through a vaporized solvent such as trichlorethylene or perchlorethylene. In less than a minute the vapor, which condenses on the cool metal and runs off, effectively removes normal soil. When the oily or greasy contamination is extremely heavy, the metal may be wiped with a solvent before entering the vapor degreaser.

Inhibited alkaline cleaners, 4 to 8 oz. per gallon of water, are generally operated at 160F to 180F. The metal to be cleaned may be sprayed or immersed in the solution for two to five minutes, after which it is rinsed in water. When cleaning parts that have small crevices, a quick dip in dilute nitric acid may be necessary as an additional rinse to remove residues from the cleaning solution. These parts are then water rinsed again before proceeding to the next finishing treatment.

For General Use

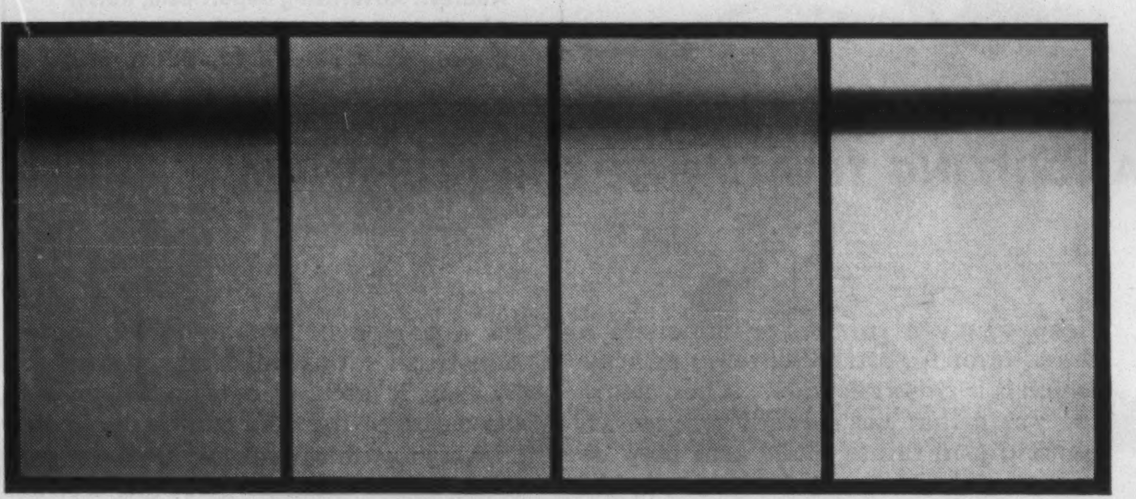
A caustic etch is one of the more common treatments used for preparing aluminum surfaces for anodizing. A typical bath would contain five per cent caustic soda. Numerous proprietary compounds of this type are available. The metal to be etched is immersed in this bath, which is usually maintained at 160F, for a period of two to five minutes. A lustrous, satiny finish can be obtained by caustic etching certain alloys, and the depth of the etch can be controlled by varying temperature, time or concentration of caustic. Variations in either the etching conditions or in the etchants may also be used for creating different shades, or degrees of total reflectivity. Sodium fluoride is frequently added to caustic etch solutions to obtain a desired effect. This addition imparts a finer, more uniform etch to the aluminum surface.



TOP: Anodized and dyed ashtrays. BOTTOM: Anodized natural color ashtrays. Normal good pre-anodizing treatment was used on ashtrays at left; normal good pre-anodizing treatment, plus Kaiser Aluminum bright dip, used on ashtrays at right.

Still finer etching can be obtained by using an acid fluoride bath which produces a white surface that has high total reflectivity. A solution of this type,

CONTINUED ON NEXT PAGE ➡



Alloy 5357 sheet anodized after various pretreatments. Note differences in specular reflectivity shown by black bar mirrored on surfaces.

which is used in finishing diffuse light reflectors, is made of a mixture of sulfuric and hydrofluoric acids.

For Minimum Loss of Metal

To clean aluminum with a minimum loss of metal prior to anodizing, a chromic-sulfuric acid mixture is used. This mixture effectively removes oil stain, oxide and heavy metal inclusions. However, it attacks the aluminum only slowly. Consequently, the anodized surface may not appear as uniform as a surface prepared with a caustic or acid etch treatment. A typical mixture of this type would contain 3.5% by weight chromic acid (anhydride) and 17.5% by weight of concentrated sulfuric acid (specific gravity 1.84). The bath is operated at 180F, and the aluminum is immersed in it for about five minutes. As in the case of caustic or acid etching, the operation can be controlled by changing any of the variables in the process.

For Decorative Purposes

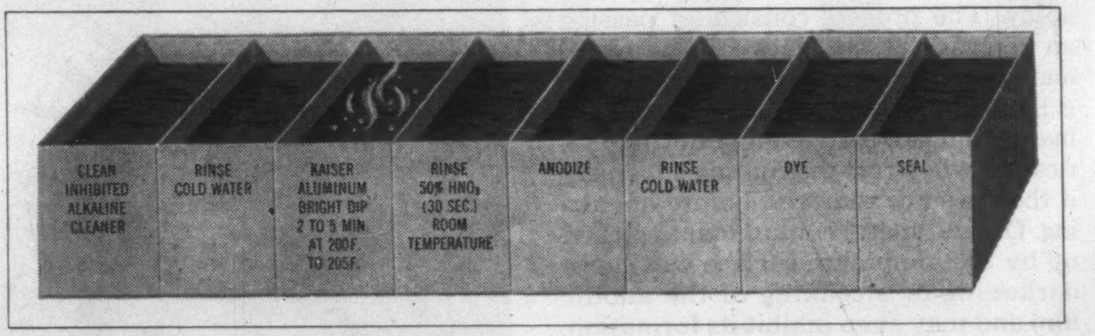
One of the chief purposes of anodizing aluminum is to provide a clear, highly reflective coating for decorative applications. The appearance of giftware, electrical appliances, automobiles, and many other products is being enhanced with brightly anodized aluminum trim of a functional or purely decorative nature. In many products, dyes are being used to add color to this metallic sparkle.

To create this attractive anodized finish the brightening process which precedes anodizing must have a uniform action across the entire surface of the metal. Several types of brightening processes are available. An electrochemical process, requiring the passage of an electric current between the metal and a special acid or alkaline bath in which it is immersed, is used on such highly polished items as light beam reflectors. Concentrated acid baths requiring no electricity during immersion may be used for cleaning and brightening a great many aluminum alloys. Unfortunately, these processes are somewhat expensive and the fumes given off during operation can create a hazard to workmen.

Dilute acid solutions are generally easier to handle and are quite effective on most alloys. Furthermore, dilute acid baths are considerably less expensive to prepare and maintain. Kaiser Aluminum Bright Dip, introduced a few years ago, is a dilute acid brightener which is being used by many anodizers of aluminum end products that depend on a pleasing appearance to increase their sales appeal.

Normal dipping time for Kaiser Aluminum Bright Dip is two to five minutes, and the bath is maintained at 200F to 205F. A flow sheet for using this Bright Dip in finishing an aluminum item which was to be color-anodized would include these steps:

1. Clean
   Inhibited alkaline cleaner
2. Rinse in cold water
3. Kaiser Aluminum Bright Dip
   2 to 5 minutes at 200F to 205F
4. 50% HNO_3 rinse (30 sec.)
   room temperature
5. Rinse in cold water
6. Anodize
7. Rinse in cold water
8. Dye
9. Seal


CLEAN INHIBITED ALKALINE CLEANER
RINSE COLD WATER
KAISER ALUMINUM BRIGHT DIP 2 TO 5 MIN. AT 200F. TO 205F.
RINSE 50% HNO₃ (30 SEC.) ROOM TEMPERATURE
ANODIZE
RINSE COLD WATER
DYE
SEAL

For other applications, such as in the architectural field, specialized anodizing techniques may be required. Techniques of this sort are the subject of continuous study by Kaiser Aluminum's Department of Metallurgical Research. Further information concerning pre-anodizing treatments may be obtained by contacting the Kaiser Aluminum sales office listed in your telephone directory, or one of our many distributors. Kaiser Aluminum and Chemical Sales, Inc., *General Sales Office,* Palmolive Bldg., 919 North Michigan Avenue, Chicago 11, Illinois; *Executive Office,* 7776 Kaiser Bldg., Oakland 12, California.

Kaiser Aluminum

see our catalog in
PRODUCT DESIGN FILE
or write for copy

setting the pace—in growth, quality and service

For more information, turn to Reader Service Card, Circle No. 528

DU PONT
REG. U.S. PAT. OFF.
Better Things for Better Living
. . . through Chemistry

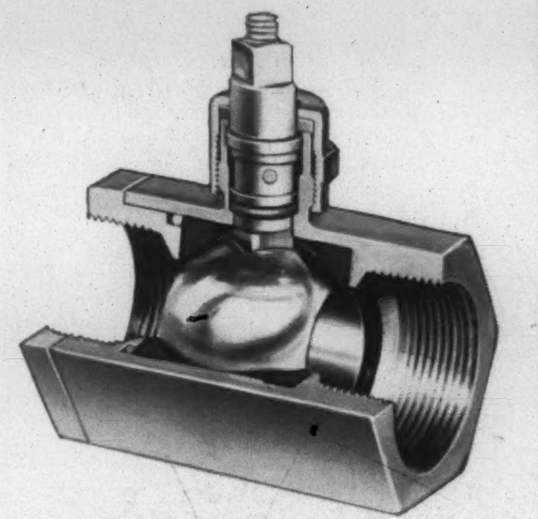
PRODUCT ENGINEERING NEWS

PROPERTY AND APPLICATION DATA ON THESE VERSATILE ENGINEERING MATERIALS: "ZYTEL," "ALATHON," "TEFLON," "LUCITE."

No. 4, 1956

Gears and housing of ZYTEL® nylon resin permit simplified, more compact paintbrush-cleaner design

Ball valve seats of TEFLON® provide tight, long-lasting, chemically inert seals



"Double-seal" ball valve manufactured by the Jamesbury Corporation, Worcester 5, Massachusetts. Processors—Crane Packing Company, Chicago, Illinois, and United States Gasket Company, Camden, New Jersey.

WITH SEATS of "Teflon", these valves are able to handle practically all known liquids and gases—through extreme temperature ranges. They also offer the advantage of economy by reducing maintenance time.

"Teflon" tetrafluoroethylene resin is inert to all chemicals normally used in industry. Only alkali metals and fluorine under special conditions affect "Teflon".

"Teflon" is non-flammable and has zero water absorption. Its chemical inertness, heat resistance (working temperature range of "Teflon" extends from −450°F to 500°F), resiliency and toughness recommend "Teflon" for use in gaskets, packings and component parts of pumps, agitators, mixers and for valve seats and discs.

Investigate the benefits of using "Teflon" in your own applications. No other single material serves so well over such a wide range of conditions.

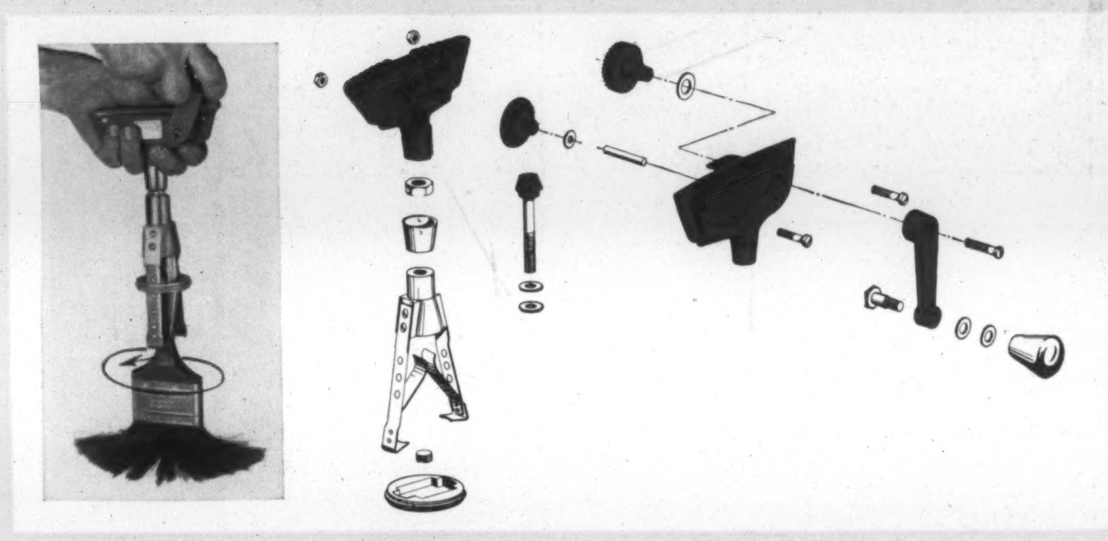


Photo of "Spin-A-Brush" cleaner in use, with exploded view showing parts of "Zytel" in red. (Parts molded by Process Gear Company and Chicago Molded Products. Manufactured by Portable Electric Tool Company, Chicago, Illinois.)

THIS hand-operated paintbrush cleaner has been designed for home or professional use. The lightweight, compactly designed unit will clean a paintbrush or paint roller in approximately ninety seconds.

A handle actuates molded gears of "Zytel", set at a 1 to 8 ratio, which spin the brush. These smooth-operating gears of "Zytel" require no lubrication and reduce backlash considerably. A self-tapping metal screw attaches the initial gear to the handle, locking the gear securely and permanently in place.

"Zytel" nylon resin was selected for this application because it is accurately and inexpensively injection molded and requires no further finishing. The bevel gear and spur of "Zytel" mold as a unit, eliminating a costly machining and assembly operation.

The use of "Zytel" made possible an improvement in styling, in addition to substantial cost savings. The comfortable palm grip housing of "Zytel" is durable, lightweight, and impervious to ordinary solvents. Each half contains several complicated inserts, and is molded to close tolerances in one operation. The parts join neatly together without grinding. The attractive grey finish requires no polishing or buffing.

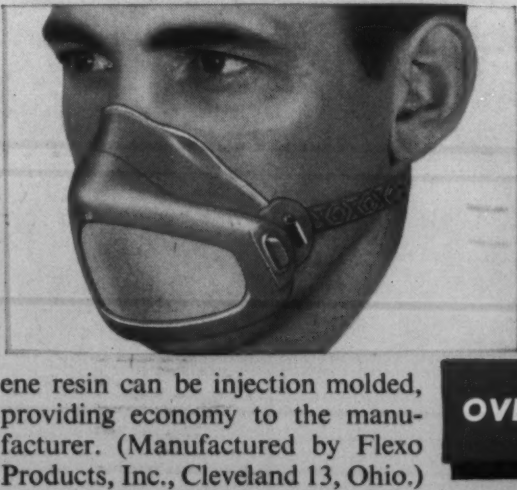
Because of its unique combination of properties, "Zytel" nylon resin does a superior job in a great variety of industrial applications. "Zytel" is distinguished by its toughness, form stability at high temperatures, and chemical resistance. Be sure to investigate Du Pont "Zytel" nylon resin. Complete property and application data are available to you without cost or obligation.

Flexibility of ALATHON® assures close fit, positive protection in dust masks

"Alathon" polyethylene resin plays a key part in this new paint and dust mask, which affords improved protection and comfort to both commercial and home users.

One of the major difficulties in protective masks—air leaks around the frame—has now been eliminated. The frames of "Alathon" are contoured and flexible, making them adjustable. Serrations on the inner edge of both frame members provide an airtight filter lock.

"Alathon" makes possible other protective benefits. Non-toxic "Alathon" is unaffected by paint or perspiration and can be easily sterilized. It is tough—unbreakable in normal usage. Du Pont "Alathon" polyethylene resin can be injection molded, providing economy to the manufacturer. (Manufactured by Flexo Products, Inc., Cleveland 13, Ohio.)



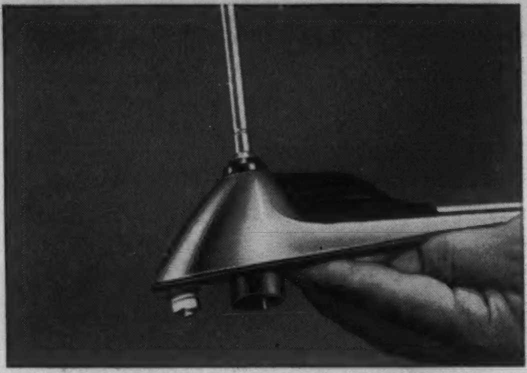
OVER

DU PONT
REG. U.S. PAT. OFF.

Better Things for Better Living
. . . through Chemistry

PRODUCT ENGINEERING NEWS

PROPERTY AND APPLICATION DATA ON THESE VERSATILE ENGINEERING MATERIALS: "ZYTEL," "ALATHON," "TEFLON," "LUCITE."

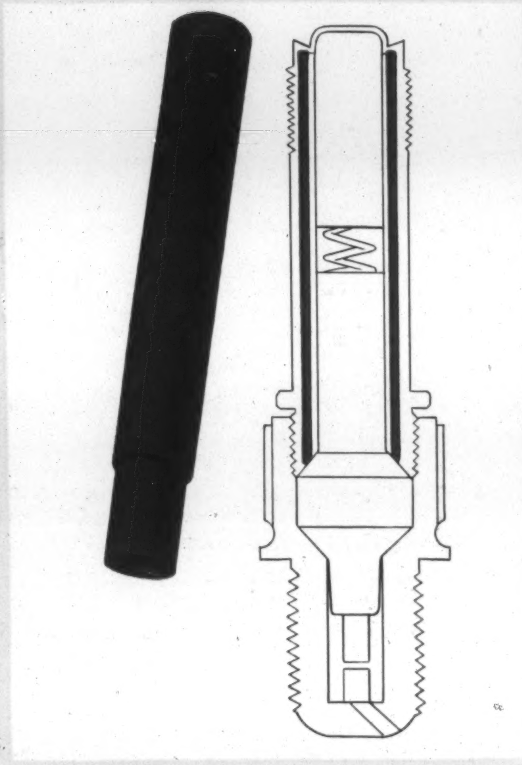


LUCITE® provides beauty and durability for antenna base

Du Pont "Lucite" acrylic resin adds a decorative touch to this auto radio antenna. "Lucite" was selected by Ford Motor Company for this job, because it is available in a wide range of attractive, non-fading colors and is unaffected by weather.

"Lucite" is shatterproof, light in weight, chemical resistant, and easy to keep clean. Because of this excellent balance of properties, Du Pont "Lucite" acrylic resin can solve a wide variety of product design problems involving long-term light transmission and outdoor weathering. "Lucite" is fabricated economically by injection and compression molding, extrusion and forming. For further information, use the coupon at the bottom of this page. (Molded by Sajar Plastics, Inc., Middlefield, Ohio. Manufactured by Tenna Manufacturing Company, Cleveland 25, Ohio.)

TEFLON® offers superior electrical and mechanical properties for aircraft spark plug insulators



Cutaway view of aircraft spark plug, showing two insulation sleeves of "Teflon" tetrafluoroethylene resin in red. (Spark plug manufactured by the Jet Ignition Company, Larchmont, New York. Sleeves of "Teflon" by Raybestos-Manhattan, Inc., Manheim, Pennsylvania.)

"Teflon" replaces ceramic . . . eliminates breakage problems

Two thin sleeves of "Teflon" tetrafluoroethylene resin outperform the ceramic insulator found in conventional aircraft spark plugs. The use of "Teflon" virtually eliminates the possibility of failure resulting from dropping, mishandling, normal engine vibration or other mechanical injury to the barrel of the plug.

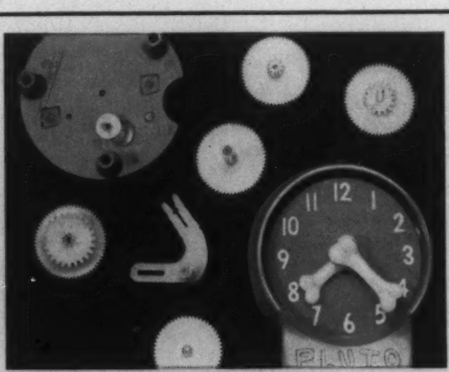
During the development and testing of the plugs, failure with standard ceramic sleeve insulators was experienced at 150 to 200 hours of operation. Failures were invariably due to the cracking of the ceramic insulator. No cracking has been observed with insulators of "Teflon", even after prolonged testing.

The insulating properties of "Teflon" are far superior to those of the ceramic sleeve. You will note from the illustration that two sleeves of "Teflon" are used—one inside the other. This provides added protection against dielectric failure.

Aircraft engine plugs with sleeve insulators of "Teflon", as illustrated, are approved by the CAA for use in the R-1820 engine and the Franklin 0-335-5 and 0-335-6 engines and are in use in these engines at the present time.

The mechanical, electrical, and chemical properties of "Teflon" have found use in a variety of design applications. Do you require material that is chemically inert? Suitable for use at extreme temperatures? Tough and resilient? For complete property data on this versatile Du Pont engineering material, mail the coupon at left.

Gear movement of "Zytel" nylon resin in Pluto novelty clock offers lightweight, compact design—plus smooth, quiet operation, with no lubrication. "Zytel" nylon resin is injection molded and requires no further finishing. Its strength and stiffness, even in thin sections, assure parts which will provide years of trouble-free service. (Clock by Allied Manufacturing Company, Seattle 44, Washington.)



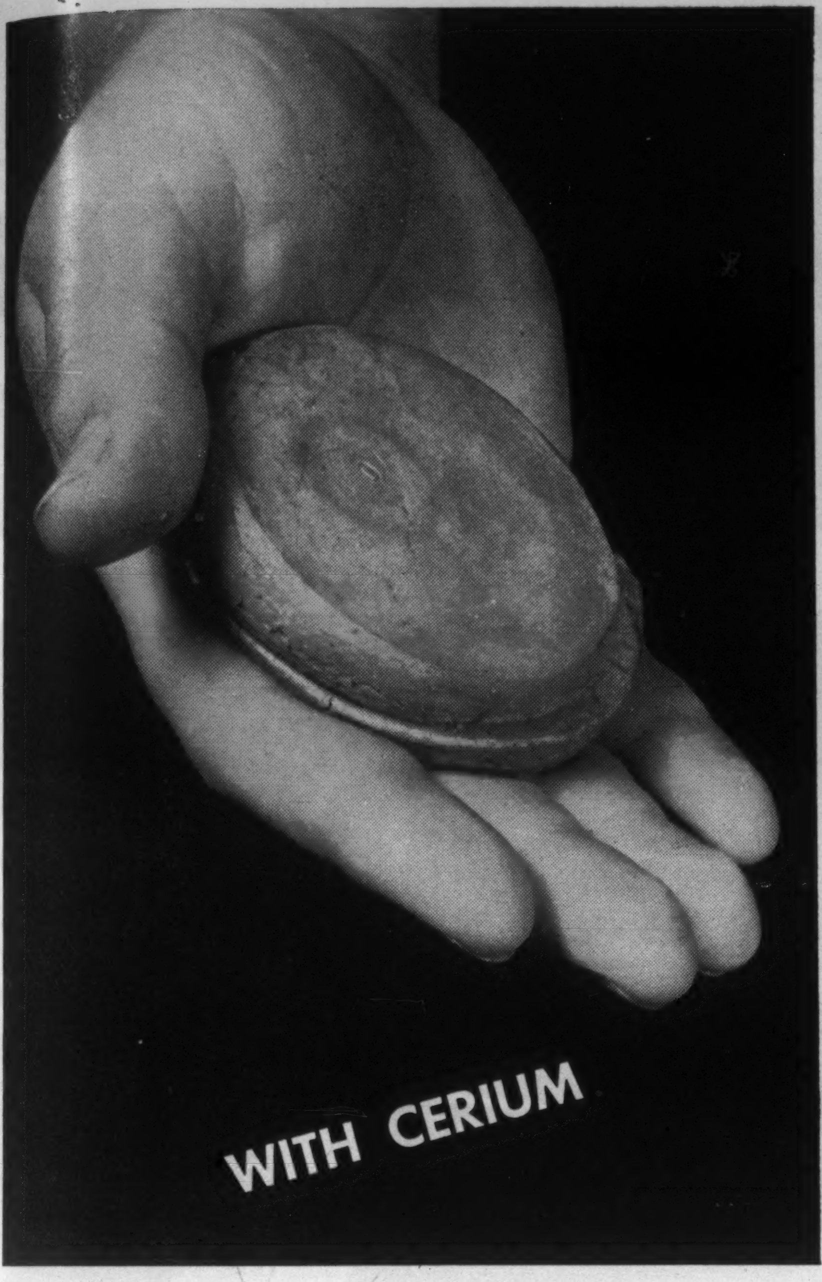
E. I. DU PONT DE NEMOURS & CO. (Inc.) POLYCHEMICALS DEPARTMENT
Room 116, Du Pont Building, Wilmington 98, Delaware.
In Canada: Du Pont Company of Canada, Ltd., P. O. Box 660, Montreal, Quebec.

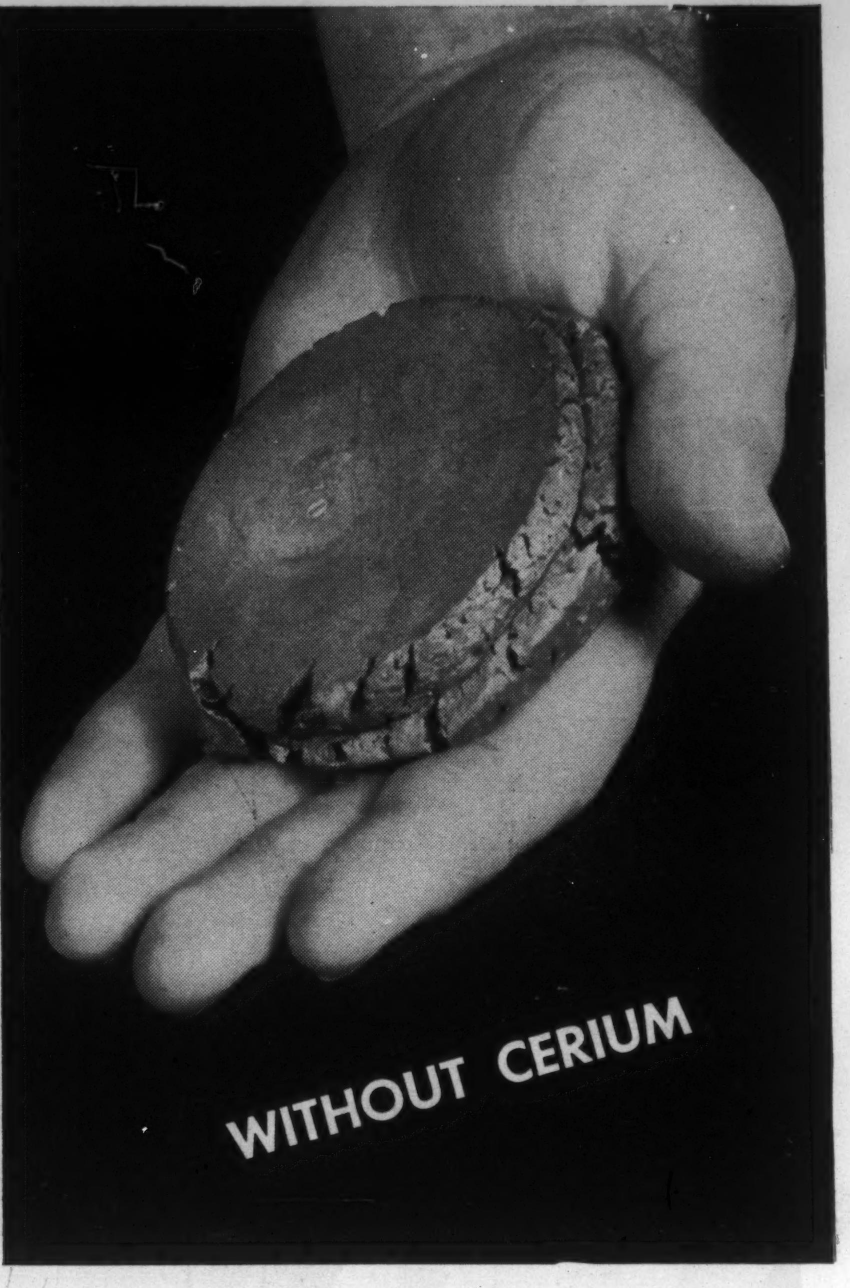
Please send me more information on the Du Pont engineering materials checked: ☐ *"Zytel";* ☐ *"Alathon";* ☐ *"Teflon";* ☐ *"Lucite". I am interested in evaluating these materials for:*

NAME ______ POSITION ______
COMPANY ______
STREET ______
CITY ______ STATE ______
TYPE OF BUSINESS ______

NEED MORE INFORMATION?

For complete details that will help you further evaluate the Du Pont engineering materials for use in your product development programs, mail the coupon at the left. Specific property and application data will be sent to you.





HOW *Carpenter* USES RARE EARTH ELEMENTS TO IMPROVE FORGEABILITY OF ALLOYS FOR ELEVATED TEMPERATURE SERVICE

The value of rare earth elements in certain alloys for elevated temperature service can be seen in this hot forgeability test. Cast cones, identical except for the addition of cerium in one, are heated to forging temperature and upset or hammered into flat "pancakes". Note the relative freedom from cracks and tears in the specimen containing cerium.

What does this improved hot workability mean to you? It means better forged finishes requiring less machine clean-up . . . less wasted steel . . . fewer rejects . . . faster fabricating.

Carpenter alloys for elevated temperature service have an enviable reputation for improved forgeability, and exceptional cleanness which meets the strictest inspection requirements.

Carpenter pioneering in tool steels, super corrosion resisting steels and free-machining stainless steels has helped hundreds of companies to improve products and cut costs. This same specialty mill experience can help you do a better, low cost job on any parts or products you make for high temperature service. It'll pay you to investigate. Contact your Carpenter Representative, or drop us a line on your company letterhead. *The Carpenter Steel Company, 135 W. Bern St., Reading, Pa.*

Specify Carpenter alloys for elevated temperature service and get these three big advantages . . .

Improved Forgeability
Greater Uniformity
Cleaner Steel

***Carpenter* STEEL**

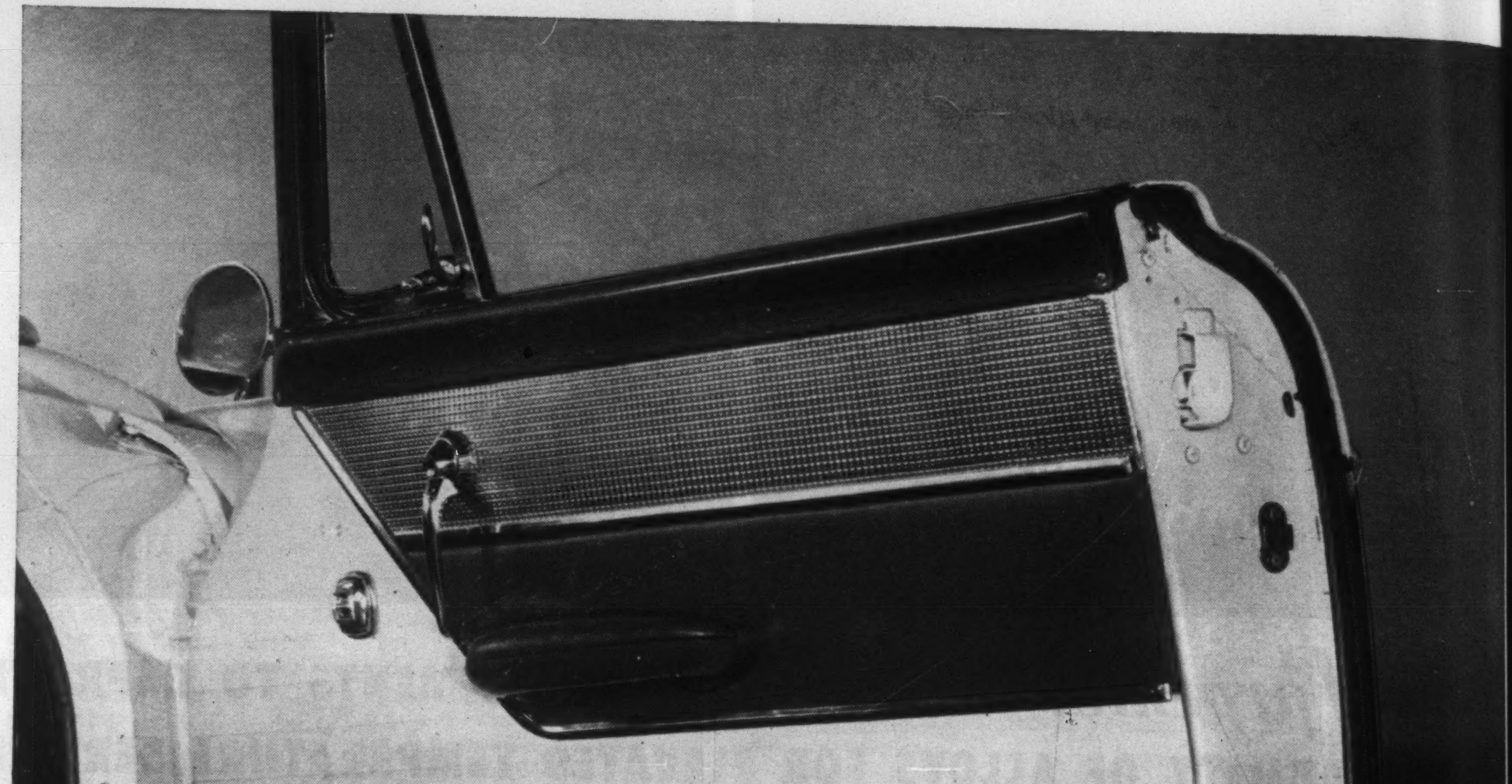
Improved Alloys for Elevated Temperature Service

◄ For more information, Circle No. 361

For more information, turn to Reader Service Card, Circle No. 389

Manufacturer of interior auto trim reports:

"Metallic trims made w
give greater freedom of de



"We've shifted to the use of laminates with 'Mylar' on all 1956 trim," reports National Automotive Fibres, Inc. "Metalized and then embossed, 'Mylar' is used to make decorative, non-tarnishing and scuff-resistant interior car trim that will, in fact, outlast the door panel itself."

"We ac
door tri
terials u
Nationa
remarka
sign nev
flexible
of attra

"Jus
saving
with 'M
cost rec
less exp
costs a
of vari
cut in

With
sign, "
install
transp
in a fu
terial
metali
decora
many

It v
alone
impro
ducti
tion c

BETTER

with Du Pont MYLAR®
design—cut costs by 80%"

"We achieved new beauty and economy in interior door trim by replacing conventional metal with materials using Du Pont 'Mylar'* polyester film," reports National Automotive Fibres, Inc., Findlay, Ohio. "This remarkably strong film has given us a freedom of design never before possible. Because 'Mylar' is extremely flexible, we are not limited in the creation of new types of attractive patterns.

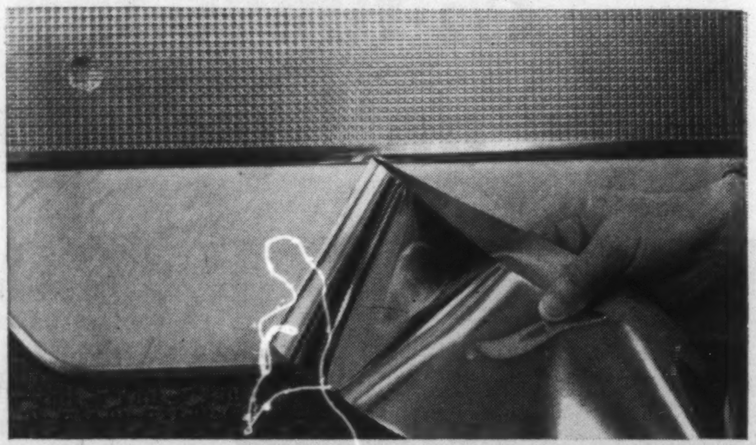
"Just as important, we have experienced an over-all saving on costs. Pressure-sensitive metallic tapes made with 'Mylar', for example, have been responsible for a cost reduction of 80%. These metallic tapes are much less expensive than conventional metals . . . inventory costs are cut by eliminating the need for large reserves of various sizes and shapes . . . installation costs are cut in terms of time and damage to metal strips."

With today's increased emphasis on functional design, "Mylar" is filling the need for a durable easy-to-install material with a quality appearance. This thin, transparent, abrasion-resistant film can be metalized in a full range of colors. Laminated to a backing material or coated with a pressure-sensitive adhesive, metalized "Mylar" gives long-lasting protection to the decorative areas of autos, airplanes, appliances and many other products.

It will pay you to investigate how "Mylar", used alone or in combination with other materials, can help improve your products, while cutting the costs of production. Mail the coupon for swatches and information on applications.

***MYLAR** *is Du Pont's registered trademark for its brand of polyester film.*

Metallic Tape made with "Mylar" reduces trim costs 80% over metal. That's because metalized "Mylar" costs less and is easier to handle and apply. And since "Mylar" is available in rolls and in a variety of widths and colors, exact sizes can be kept on hand . . . saves on cutting and inventory expense.



Because of the great strength and flexibility of "Mylar", there's greater freedom of design. Manufacturers can create more attractive patterns that were difficult, often impossible, with metal. "Mylar" can't loosen or break off . . . stays clean and bright under the most rugged conditions.

DU PONT
REG. U. S. PAT. OFF.
BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

DU PONT
MYLAR®
REG. U. S. PAT. OFF.

E. I. du Pont de Nemours & Co. (Inc.)
Film Dept., Room MM-6, Nemours Bldg., Wilmington 98, Del.

Please send your booklet with swatches of materials surfaced with "Mylar" polyester film plus information on applications (SF-4, MB-7).

I am interested in "Mylar" for..

Name______________________________

Firm______________________________

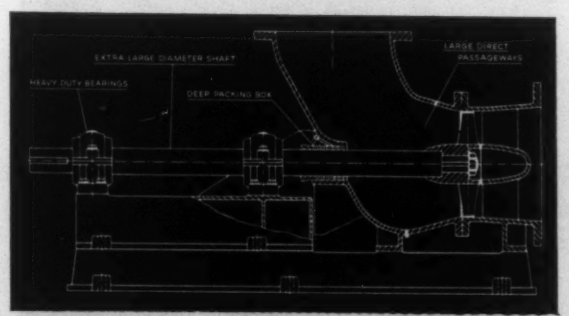
Address______________________________

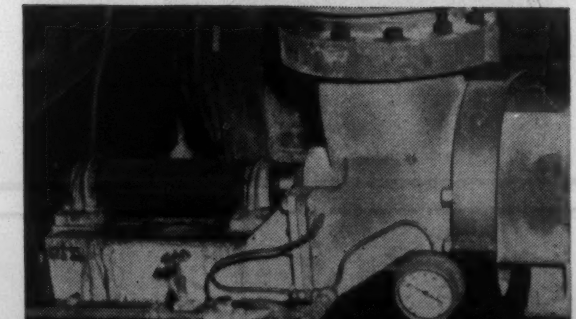
City____________________ State__________

For more information, turn to Reader Service Card, Circle No. 529

May save several "G's"! In this elbow pump, handling 2200 GPM of mixed caustics, National Aniline expects . . .

2½ times the life from INCO's new anti-galling "G" Nickel castings





←"G" Nickel halts wear and erosion
In elbow, propeller, water ring, end cap and casing, Inco "G" Nickel resists cavitation-erosion. In glands and shaft . . . wear and abrasion. Made for National Aniline Division, Allied Chemical & Dye Corporation, by Lawrence Pumps Inc.

This *was* a trouble spot.

For this pump dwells in corrosives, potassium and sodium hydroxide with carbonates and organic impurities.

Once tinkering was constant . . . "down-time" high. Now, for eight months, only packing has been needed. Once 41 days to two years life was "max." Now, engineers expect five years. Once the pump was made conventionally. Now, it's "G"® Nickel cast by Inco.

"G" Nickel is a specially developed cast form of Inco Nickel with greater resistance to galling . . . the same resistance to abrasion, corrosion and erosion and the same mechanical properties.

Maybe "G" Nickel would help you overcome trouble. Or, maybe you should explore Inco's seven other casting alloys . . . each developed to provide strength and resist corrosion, abrasion, erosion and other conditions.

Get this new booklet

"Cast to Outlast," new 16-page booklet shows how to apply Inco alloys. Gives basic properties, how to machine and join. Just write.

The International Nickel Company, Inc.
67 Wall Street New York 5, N. Y.

INCO
TRADE MARK

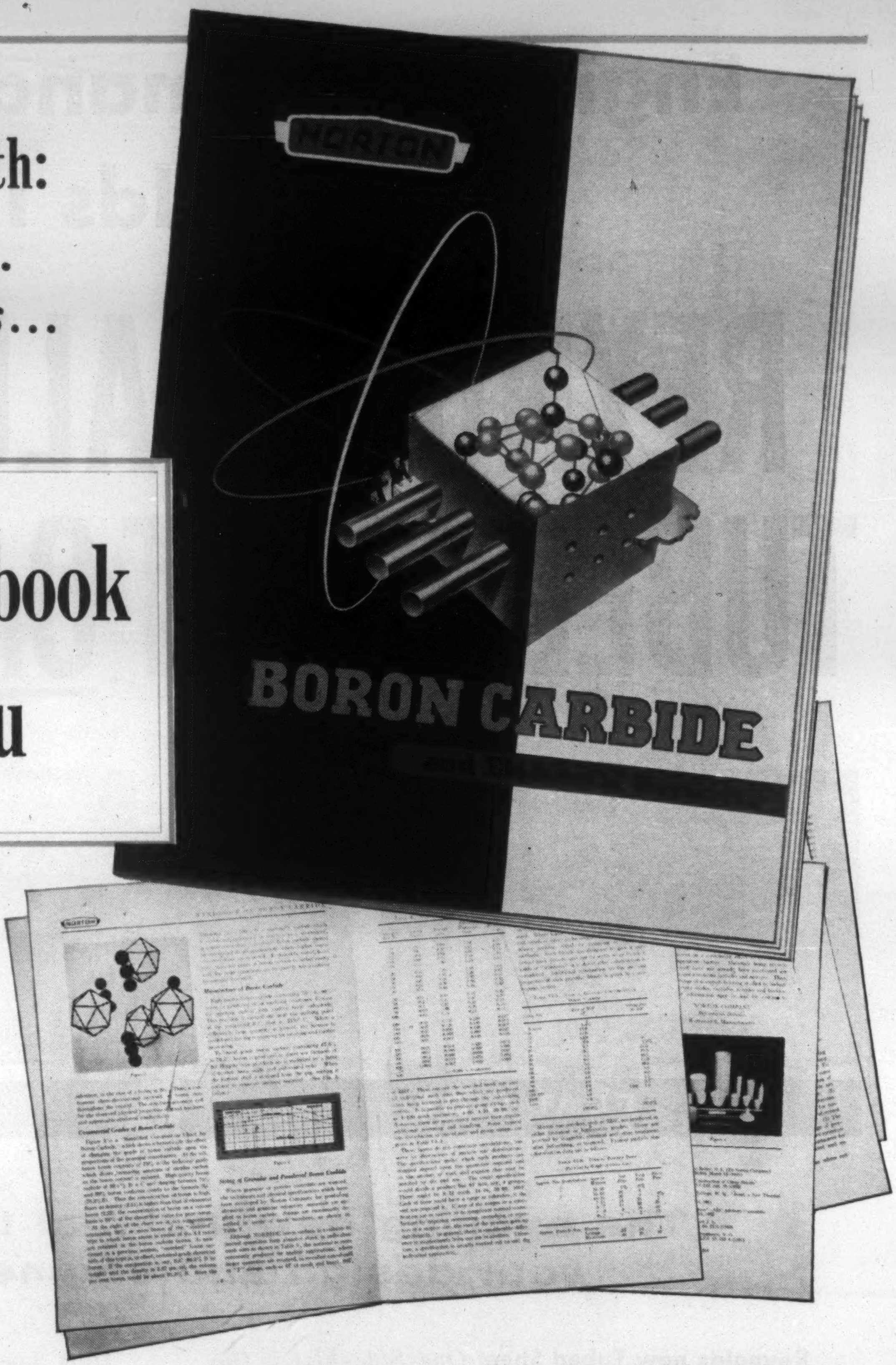
Inco Castings . . . Sand, Centrifugal, Precision

For more information, turn to Reader Service Card, Circle No. 372

If you are concerned with:

Reactor development...
Atomic energy projects...
Nuclear problems...

This new data book will help you



This new free Norton *"Handbook on Boron Carbide and Elemental Boron"*, is a valuable reference, containing both fundamental data and practical information. Printed in colors with many charts and tables it will serve as a useful and permanent addition to the reference files of those concerned with atomic energy and related fields.

In nuclear science and engineering the importance of the neutron absorption reaction of the boron isotope B^{10} is well recognized.

Now, for the first time, available data on the development of numerous stable, boron-rich materials have been compiled and coordinated by Norton in one convenient reference book.

This book is the *"Handbook on Boron Carbide and Elemental Boron"* — a compact source of technical information on materials made by Norton for use in the atomic energy field.

A partial list of the table of contents includes: *Boron for neutron absorption . . . Technical grade boron . . . Properties of boron . . . Commercial grades of boron carbide . . . Radiation damage to boron carbide . . . Bonded boron carbide (carbon, silicate, plastic, metal) . . . Boron nitride . . . Metal borides.* These and many other subjects are fully described and illustrated with tables, charts and photographs.

A Quarter-Century of Experience

Work in Norton laboratories on boron compounds began some 25 years ago. This included the development of NORBIDE* boron carbide, the hardest material yet produced commercially. Norton facilities for producing NORBIDE wear-resistant articles and abrasive have been expanded to supply boron carbide in numerous forms for atomic energy applications.

Recent Norton development has been aimed at improving the quality, increasing the production and reducing the costs of various boron-rich products. As a result, Norton now produces these materials to highest purity standards, at prices ranging between one-half and one-tenth of former pricing.

Other Norton Electric Furnace Products

of special interest to nuclear engineers include ALUNDUM* fused alumina, CRYSTOLON* silicon carbide, MAGNORITE* magnesium oxide, FUSED ZIRCONIA and various refractory carbides, oxides and nitrides.

Besides being the basic ingredients of the famous Norton Refractory ℞'s — refractories *engineered and prescribed* for the widest range of conventional applications — these high-melting materials are finding many new and valuable uses in atomic energy projects.

They are all described in the new Norton handbook. For your free copy, write to NORTON COMPANY, Refractories Division, 345 New Bond St., Worcester 6, Massachusetts.

NORTON
REFRACTORIES
Engineered... ℞... Prescribed
Making better products... to make your products better

*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries.

For more information, turn to Reader Service Card, Circle No. 413

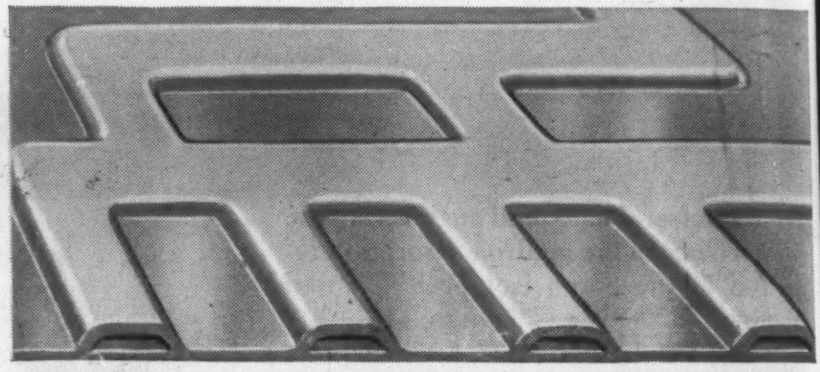
Engineers Demanded It!

Reynolds Invented It!

REYNOLDS ALUMINUM TUBED SHEET One-Side-Flat

(Patent Pending)

FLAT SIDE



PATTERN SIDE

The exciting new material to complement your design and engineering skill

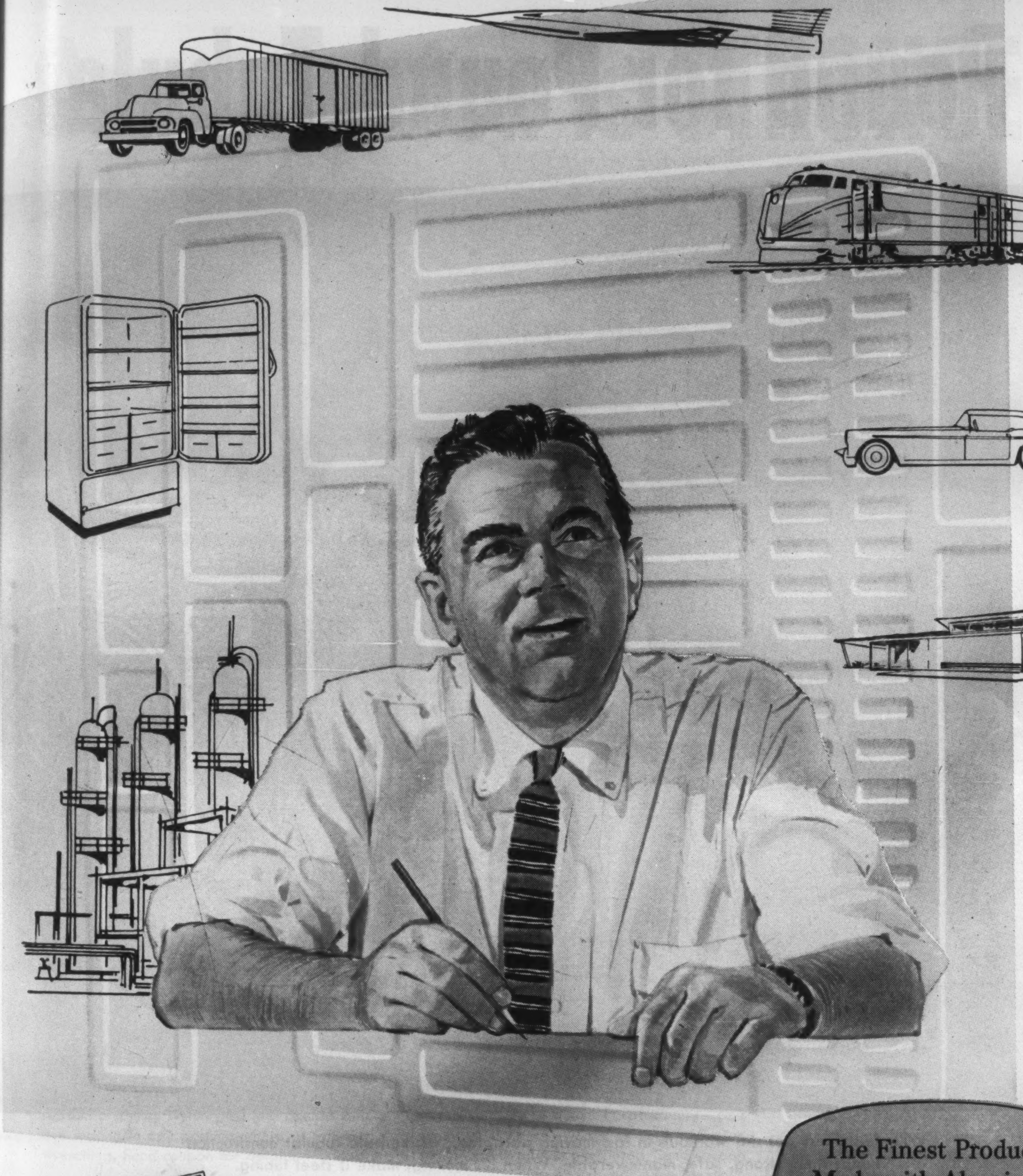
Reynolds new Tubed Sheet *One-Side-Flat* is the only sheet with one flat side providing integral tubing in any parallel or non-parallel patterns no matter how complex! Tubed Sheet *One-Side-Flat* (two sheets of aluminum metallurgically bonded together so that the heat transfer passageways are *in the sheet*) is flat on one side and has the built-in tubing pattern on the other side. This amazing material routes gas or liquid wherever needed with greater freedom and greater efficiency and at lower costs.

Like the original Reynolds Tubed Sheet that has its integral tubing pattern expanded on both sides and is widely used in the refrigeration industry, this exclusive new Reynolds development is exciting interest in the refrigeration and other industries because it promises *even more advantages.*

For example, in *refrigerator evaporators*, Tubed Sheet *One-Side-Flat* permits direct contact of the flat side with food packages and ice cube trays thus speeding heat transfer, providing faster freezing. As a *skin for aircraft*, its flat side provides a smooth exterior and the entire sheet can be cooled through the integral tubing offering a possible solution to the "heat barrier" faced by supersonic planes. In *radiant heating panels for buildings*, its flat surface can be finished in a variety of decorative ways and used to face room interiors while hot water is circulating through the integral passageways on the other side of the sheet.

Why not investigate Reynolds Tubed Sheet *One-Side-Flat* for application in your industry? Whether transportation, chemical, petroleum, construction, appliance or other industry, you'll find it an intriguing new material—for amazingly flexible heat transfer use or for other uses your ingenuity may devise. For details contact your nearest Reynolds Office or write direct. *Reynolds Aluminum Fabricating Service, 2060 South Ninth Street, Louisville 1, Kentucky.*

See "Frontier", Reynolds exciting dramatic series, Sundays, NBC-TV.



Write for free 24-page "Catalog of Facilities". Get full details on the tremendous production facilities of Reynolds Aluminum Fabricating Service.

The Finest Products Made with Aluminum

are made with

REYNOLDS ALUMINUM

© REYNOLDS METALS COMPANY

REYNOLDS ALUMINUM FABRICATING SERVICE

BLANKING • EMBOSSING • STAMPING • DRAWING • RIVETING • FORMING • IMPACT EXTRUDING • ROLL SHAPING • TUBE BENDING • WELDING • FINISHING

For more information, turn to Reader Service Card, Circle No. 476

WHEN IT'S *MOVING*...MAKE IT *TUBING*

Pound for Pound, Tubular

Wheeled chairs get stiff workouts in fast-moving paraplegic basketball. Tubular construction keeps them strong, safe, maneuverable. When it's moving, make it steel tubing.

REPUBLIC

REPUBLIC STEEL ®

World's Widest Range of Standard Steels

Construction is STRONGEST!

At any given weight, tubing is strongest of all mechanical shapes . . . stronger under compressive load . . . stronger as a beam . . . stronger in torsion.

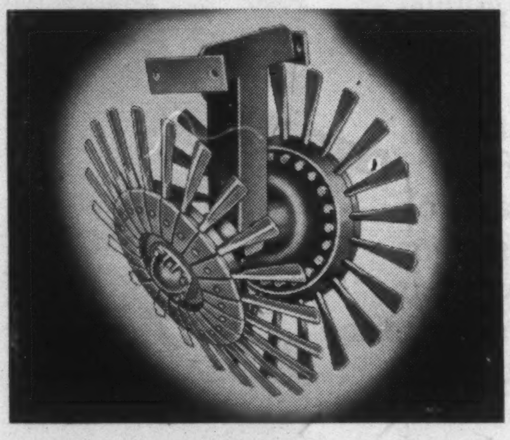
And, dollar for dollar Republic ELECTRUNITE Steel Mechanical Tubing is your best buy. ELECTRUNITE is the original electric resistance welded tube. It's the quality tube of industry, available in a wide variety of forms, sizes and gages . . . in both carbon and stainless steel.

For volume production, ELECTRUNITE tubing is consistently uniform, foot to foot, shipment to shipment. It offers uniform wall thickness and concentricity. Surfaces are free from scratches and pit marks. It offers uniform response to heat treatment. It is easy to fabricate . . . often eliminates some costly fabricating or machining operations.

When your product must be strong, safe, lightweight, investigate Republic ELECTRUNITE Steel Tubing. Republic engineers can help you design it into your products and processes, economically and profitably. Send coupon for facts.

MORE REPUBLIC PRODUCTS MADE FOR MOVEMENT:

"I PUT REPUBLIC NYLOK NUTS TO THE TEST every time I ride my Taylor Tot," reports this young test driver. In spite of all the bumps, bounces and jolts, Nylok Nuts always hold tight. The reason: a special Nylon plug that assures positive locking in any position wherever you stop wrenching. Send coupon for details.



THESE BEET DIGGER TINES ARE 24% STRONGER since John Deere switched to alloy steel. Originally fabricated from carbon steel, they would sometimes break under stress. By taking advantage of alloy's hardenability—plus superior strength—bending and abrasion problems have been eliminated. Send coupon for complete data on Republic Alloy Steels.

DOUGLAS AIRCRAFT ADDED A PASSENGER—AT NO INCREASE IN WEIGHT on their new DC-7 superliner. How? By substituting Titanium for other metals normally used in nacelle construction. Republic is an old hand at this high strength-to-weight business. Send coupon for information on how Republic Titanium and Titanium Alloys may help your product.

REPUBLIC STEEL

and Steel Products

REPUBLIC STEEL CORPORATION
Dept. C-1249
3176 East 45th Street
Cleveland 27, Ohio

Please send me more information on:
☐ ELECTRUNITE® Mechanical Tubing ☐ Alloy Steels
☐ NYLOK* Nuts ☐ Titanium

*U. S. Pat. No. 2,450,694 and pending applications.

Name__________Title__________
Company__________
Address__________
City__________Zone_____State_____

For more information, turn to Reader Service Card, Circle No. 403

YOU ARE LOOKING AT ONE THING *Corrosion* CAN'T TOUCH

It is a sheet of Tygon plastic. Flexible enough you can fold it in your hand. Tough enough to outwear leather many times over. It shrugs off with equal ease — both acids and alkalies.

How is it used? In many ways. In sheet form as a protective lining for tanks containing corrosive chemicals; or as gasketing in critical sealing operations. Far more resistant to chemical attack than rubber, far easier to install, Tygon possesses the unusual property of being neutral, neither affecting nor affected by the vast majority of industrial chemicals.

As tubing — in bores ranging from .120″ to 2″ — Tygon pipes acids, alkalies, pharmaceuticals, beverages, milk, liquid foods, blood plasma — highly critical and sensitive solutions — in perfect safety. Glass clear, flexible as a piece of string, Tygon Tubing is the standard of research laboratories the world over.

As a liquid Tygon serves both as a paint and as a dip coating. Applied by brush or spray, it protects metals and concrete from attack by acid fumes.

Tygon molds as readily as rubber, and in this form extends its protective qualities over an almost unlimited range of intricate shapes.

If corrosion is a problem to you — Tygon may prove the perfect answer.

WRITE FOR THIS FREE TYGON PORTFOLIO

Detailed technical data on the use of Tygon in its various forms, arranged in a convenient reference binder.

Address: The U. S. Stoneware Company
Plastics and Synthetics Division
Dept. MM-656
Akron 9, Ohio
Ask for the TYGON PORTFOLIO.

PRODUCT OF

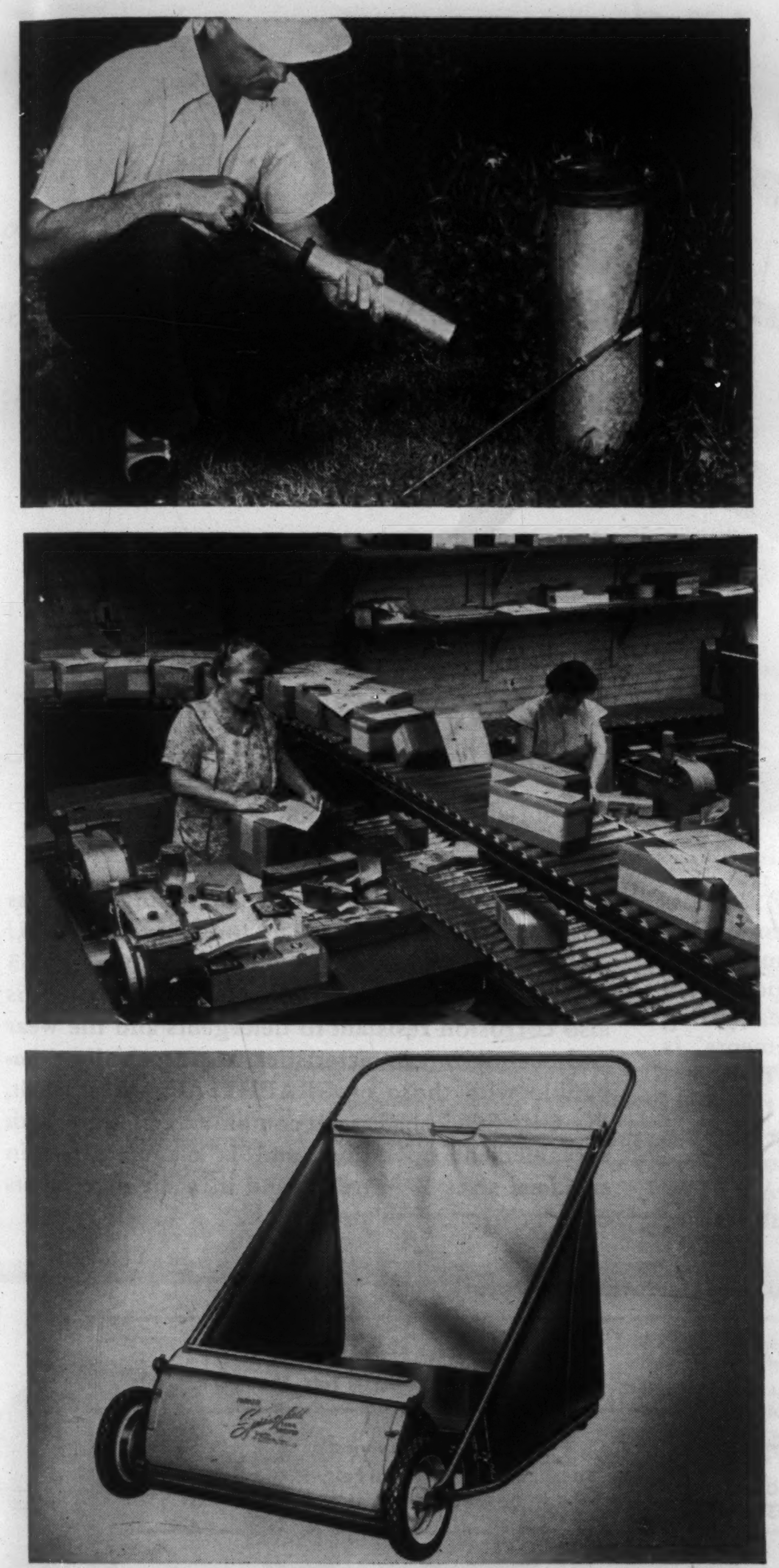
U.S. STONEWARE
Akron 9, Ohio

Plastics and Synthetics Division

376-D

For more information, turn to Reader Service Card, Circle No. 380

Two Ways Armco ZINCGRIP Steel Tubing May Help You Cut Costs, Build Sales



Typical applications where ZINCGRIP Tubing helps build sales and cut costs.

Besides the cost-saving design possibilities offered by steel tubing, Armco ZINCGRIP Tubing can give your products a big plus value: **It is the protection of a special zinc coating.**

Long Product Life

The mill-applied, hot-dipped zinc coating, on inner and outer walls of the tubing, is assurance of extra durability for your products . . . more satisfied customers. And the smooth, attractive finish of ZINCGRIP Tubing can give your products another powerful selling point.

Economy in Fabrication

With ZINCGRIP Steel Tubing you can take full advantage of the weight reductions possible with rigid tubular construction. Easy-to-fabricate, lighter-weight products can save you money and help boost sales.

You can bend, join, flange, upset or bead Armco ZINCGRIP Tubing on standard equipment. The special zinc coating *stays on* . . . doesn't flake or peel in fabricating operations.

For Your Products?

Manufacturers of conveyor rolls, farm equipment, lawn mowers and sweepers, TV antennas and scores of other products are making profitable use of Armco ZINCGRIP Steel Tubing. Why not consider its advantages for the products *you* make or use?

Just fill out and mail the coupon. We'll send you complete information.

ARMCO STEEL CORPORATION
1526 Curtis Street, Middletown, Ohio
Send me more information on Armco ZINCGRIP Steel Tubing.

We manufacture______________________

Name______________________

Company______________________

Street______________________

City______________ Zone____ State______________

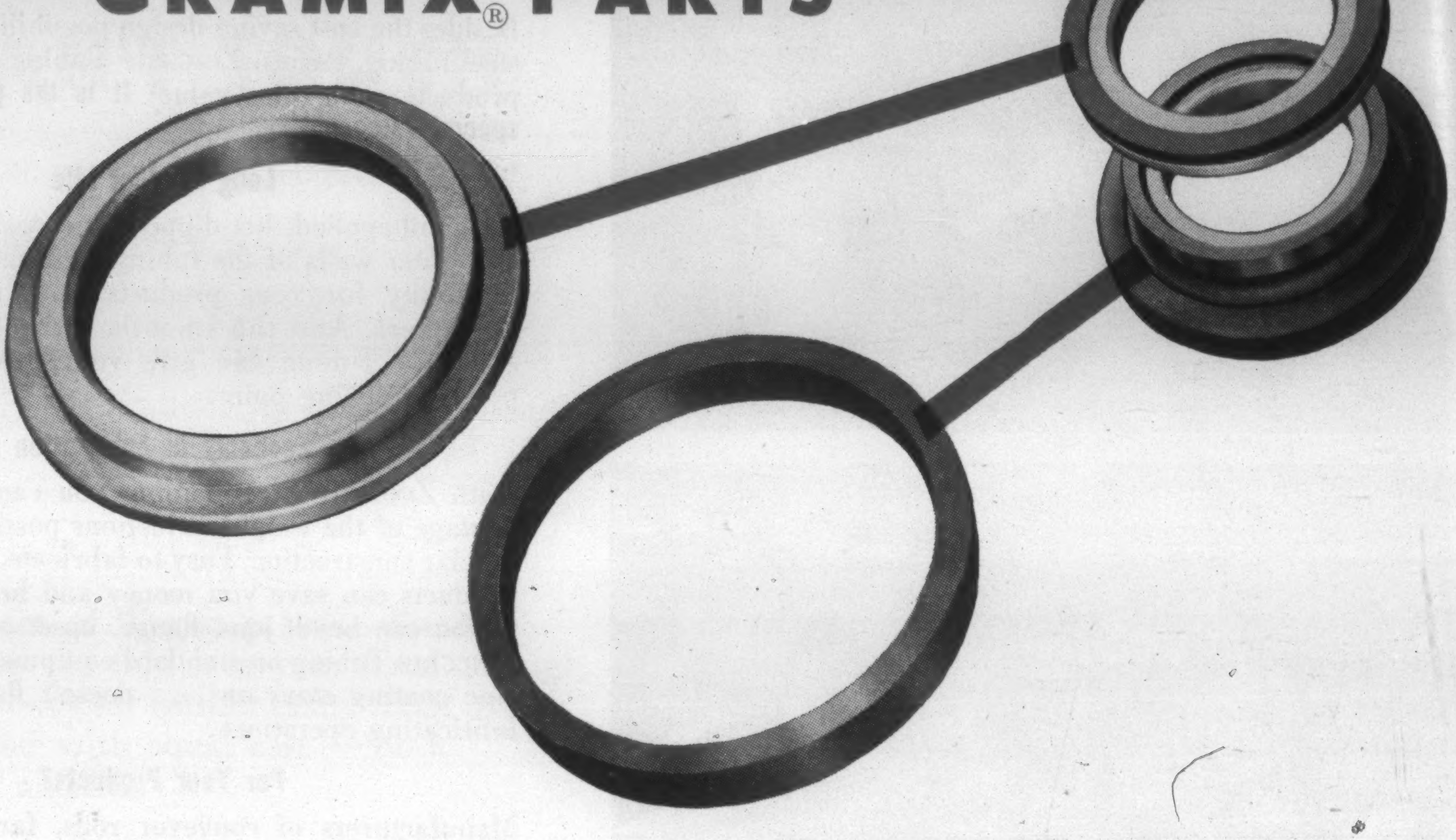
ARMCO STEEL CORPORATION
1526 CURTIS STREET, MIDDLETOWN, OHIO

SHEFFIELD STEEL DIVISION • ARMCO DRAINAGE & METAL PRODUCTS, INC. • THE ARMCO INTERNATIONAL CORPORATION

For more information, turn to Reader Service Card, Circle No. 446

efficient, long-wearing seals produced a reasonable cost with compatible

GRAPHITAR® *and* GRAMIX® PARTS



GRAPHITAR is not only a high-quality seal material, but when produced in volume, an economical one as well. In low-pressure applications where mechanical seals have heretofore been too expensive, the Gits Bros. SGU stock shaft seal, using GRAPHITAR wearing and sealing elements, is finding wide use. Cost of the GRAPHITAR seal rings is reasonable enough to make the SGU practical in such high-volume products as washing machines, garbage disposal units, and pumps. Performance is excellent, due to GRAPHITAR'S low friction, high strength, durability, self-lubricating properties and its guaranteed continuing inertness to all known detergents. The long life of the SGU seal is further assured with a GRAMIX Grade 263 nickel-bronze seal-seat. GRAMIX Grade 263 is also corrosion resistant to detergents and the wear and sealing-in characteristics are especially compatible with those of GRAPHITAR. As a result, the Gits SGU shaft seal combines economy with very efficient operation, and is manufactured in standard sizes ¼" thru 2" and in shaft increments of ⅛".

SGU Seal Performance Data:

Speeds	**1750 to 3600 FPM**
Temperatures	
Continuous	**250°F.**
Intermittent	**275°F.**
Pressures	
Normal	**10 to 15 psi**
Maximum	**35 to 40 psi**

Sealed Liquids
Soaps, Greases, Animal Fats, Strong Detergents
Lubrication
Soaps, Greases, Animal Fats, Strong Detergents and water splash lubricrtion

THE UNITED STATES

209

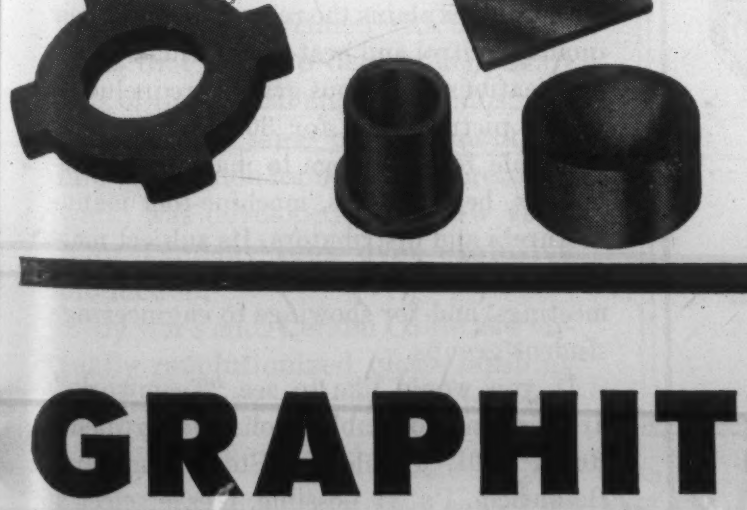
new high performance
seals withstand extremes of
speed, heat, pressure...

use GRAPHITAR® SEAL RINGS

The Gits Bros. style HH stock shaft seal has been designed for use in aircraft accessories and in other equipment where maximum performance is demanded. This seal meets minimal space requirements, and, due to its GRAPHITAR seal ring, can perform under extremes of temperature, pressure, and seal face surface speed. GRAPHITAR, being an inert carbon-graphite material, is relatively unaffected by such extreme operating conditions, and is likewise unaffected by most chemicals or acids . . . even very corrosive ones. GRAPHITAR possesses excellent sealing qualities, a low coefficient of friction, a long wear life, and is in addition self-lubricating. These properties assure the HH seal of efficient operation with a minimum of maintenance . . . very important in such end uses as jet aircraft, reciprocating accessory units, and hydraulic pumps. Gits Bros. manufacture these seals in *standard sizes* ¼″ thru 4″ and in shaft increments of 1/16″.

HH SEAL Performance Data:

Speeds . . . . 20,000 feet per min.	*Sealed Liquids* Aircraft fuels and oils
Temperatures . . . . 400°F. maximum	
Pressures . . . . 1000 psi maximum	*Lubrication* Mists, vapors, full fluid



VERSATILE GRAPHITAR seals, bearing, vanes, piston liners, and many other parts show improved characteristics. GRAPHITAR parts are made from carbongraphite powders compacted in dies under great pressure and furnaced at temperatures near 4500°F. They can be relatively complicated in shape, and are ground to tolerances as close as .0005″. GRAPHITAR is lightweight, strong, and durable, chemically inert, and virtually unaffected by extremes of speed, pressure, or temperature. It can be operated dry, or where water, steam or another fluid are the only lubricants. Write today for our illustrated 64-page GRAPHITAR catalog.

GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION, SAGINAW, MICHIGAN

For more information, turn to Reader Service Card, Circle No. 520

Tool Steel Topics

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

Airplane Builder's Change to Bearcat Increases Life of Rivet Sets 5 Times

At the Wichita, Kans., plant of Boeing Airplane Company, rivet sets used on the B-47 and B-52, as well as other types of aircraft, had been providing satisfactory results. But, Boeing engineers reasoned, by checking the performance of other grades of tool steel in the same application, they might discover a tool steel that could do a better, more economical job.

So they ordered Bearcat, from Ford Steel Company, their Bethlehem tool-steel distributor in St. Louis. The results were impressive. The Bearcat sets gave five times longer service life then the sets previously used. In addition, the heads also drove down better, thus minimizing time lost in reworking, and facilitating ready acceptance by Boeing inspectors. Besides, with Bearcat's superior finish, there was less surface pick-up.

Bearcat is our super-tough, air-hardening general-purpose grade. It has exceptional resistance both to shock and to wear. Its air-hardening characteristic minimizes quenching hazards, and provides excellent resistance to distortion in heat-treatment.

In addition to rivet-set applications, Bearcat can be used advantageously for punches, chisels, hot headers, gripper dies and master hobs, as well as for dies used in blanking and bending, and cold-forming.

If you'd like to know more about Bearcat, or perhaps try it out in your shop, just get in touch with the nearest Bethlehem tool-steel distributor.

BETHLEHEM TOOL STEEL ENGINEER ASKS:

How Hard Should Tools Be?

It is sometimes difficult to determine the best hardness for certain tools. As all tools are subjected to wear it is ordinarily desirable to use the highest possible hardness. With most tools, this causes brittleness or breakage, making some compromise necessary. Generally speaking, tool hardness should be lowered from the maximum to a degree which causes the tools to consistently wear out in service, rather than fracture. The optimum hardness for a given type of tool often varies considerably, depending upon the operating conditions. However, here are the average hardnesses of commonly used tools:

TOOL	HARDNESS ROCKWELL C
High-speed steel, metal-cutting tools, single point	65
High-speed steel, metal-cutting tools, multiple point	63
Blanking dies	60
Forming dies	60
Drawing dies, hardened all over	60
Drawing dies, bore-hardened only	66
Gages	60
Shock-resisting tools (punches, etc.)	58
Hot-work tools	40/50
Cold shear blades	60
Hot shear blades	48
Tools subjected to max tensile loads (cylinders, containers, etc.)	53
Tools subjected to max compressive loads (plungers, punches, etc.)	60/65

These hardness figures should be used as a guide only, because for individual jobs the required hardness may be slightly higher or lower, depending upon circumstances.

Tool Steel Color Film An Award Winner

"Teamwork," Bethlehem's 16-mm color film on tool steel, received an award for excellence in the sales promotion field at the recent Columbus Film Festival, held at Columbus, Ohio. The film, being received enthusiastically in all parts of the country, shows the manufacture of Bethlehem tool steels, and explains the reasons behind their quality control and heat-treatment. Typical applications of various grades are included.

The picture runs for 30 minutes. It is available for showings to machinists, die-makers, heat-treaters, machine-tool manufacturers and distributors. Its subject matter makes it excellent for technical society meetings, and for showings to engineering-student groups.

If you would like to see "Teamwork," drop a line to Publications Department, Room 1001, Bethlehem Steel Company, Bethlehem, Pa. If possible, please select a showing date well in advance, to permit adequate time for scheduling and shipping.

For more information, turn to Reader Service Card, Circle No. 447

CERIUM OXIDE

—a rare earth that sparked a revolution in a long established art in the glass industry

a report by LINDSAY

Some twenty years ago in Switzerland, two technicians discovered the amazing glass polishing properties of Cerium Oxide. Soon it was being used extensively for polishing of precision lenses in Europe.

Then came World War II. Scientists in the optical industries in this country heard about Cerium Oxide . . . how it could polish faster and cleaner than any other known material. They thought that maybe this was the answer to the problem of accelerated production of precision optical pieces for our war machine. In a cloak and dagger operation, samples of Cerium Oxide were smuggled out of Switzerland. Tests confirmed the rumors . . . Cerium Oxide was IT!

This was early in the 40's when Hitler held most of Europe and the Japanese were driving toward Australia. The urgency of our growing war effort was putting fantastic demands on the optical industry. Lenses for bombsights, range finders, periscopes and other military instruments were needed desperately. Production had to be increased manyfold with no sacrifice of split-hair accuracy.

Lindsay, the nation's largest processor of monazite (the chief source of rare earths), undertook in 1942 the challenging task of producing Cerium Oxide. Day after day, Lindsay technicians worked with patience and speed to solve the inevitable production problems and in a remarkably short time, Cerium Oxide was being refined with the properties that met the demanding standards of the optical and glass industries. At about the same time, Barnesite, a rare earth oxide for ultra-high precision work, was developed and a few years later Lindsay took over exclusive production.

By war's end, Cerium Oxide had virtually revolutionized glass polishing practices in this country. Today, it is widely used in the production of distortion-free TV tubes, fine quality mirrors and precision optical lenses.

Opticians like Lindsay's Cerium Oxide (sold under the trade name Cerox) because it enables them to polish lenses to prescription specifications faster and to give you glasses exactly as the doctor ordered.

Leading automobile manufacturers use Lindsay's Cerium Oxide to polish out windshield scratches just before shipment. One of the largest producers furnishes its dealers with kits containing Cerium Oxide to remove nicks and scratches picked up in transit.

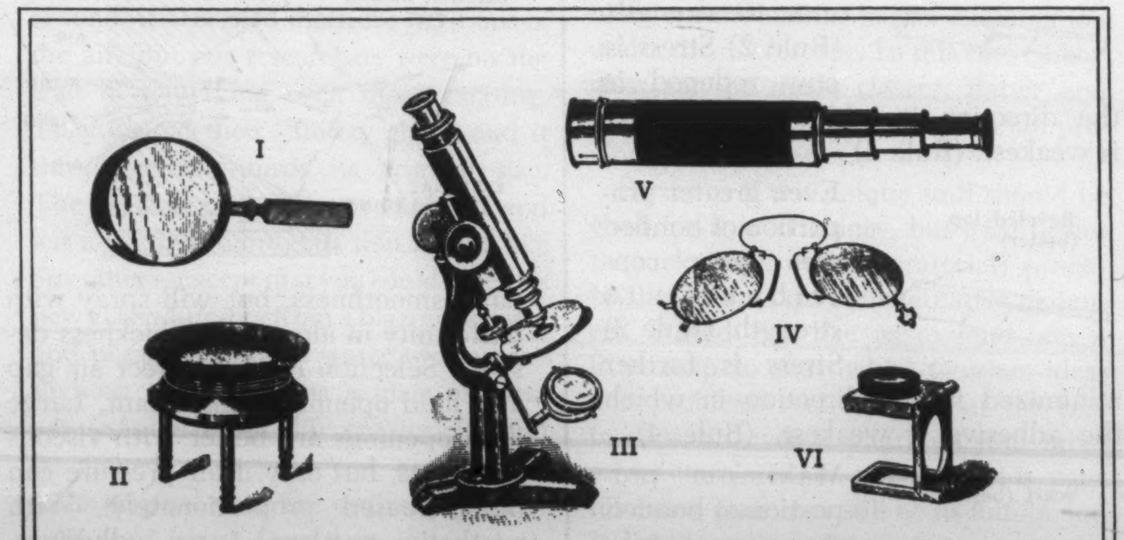
Why is Cerium Oxide such wonderful stuff when it comes to polishing? Frankly, nobody knows. Lindsay's technical people have tested and retested it, put it through countless laboratory analyses and peered at it for hours through high-powered microscopes. Just as scientists know how to *use* electricity, but don't know what it *is*, so too, they know that Cerium Oxide is a remarkably efficient polishing agent but *why* is still a mystery.

Like all the other rare earths, Cerium Oxide is a versatile material. Research disclosed its unique potentials (along with didymium, neodymium, and other rare earths) for use in coloring and decolorizing glass and it is extensively used for that purpose. Another interesting use is as a catalyst with some chemical materials.

Twenty-five years ago, most chemists had little knowledge or curiosity about the rare earths. Then the dramatic emergence of Cerium Oxide as an important factor in the optical industry excited interest in the full range of the 15 rare earth elements—atomic numbers 57 through 71.

There are technical people who think that some of the rare earths have greater possibilities of revolutionizing processes in their industries than Cerium Oxide has had for polishing practices. We are encouraged to think so, too. We are shipping rare earths regularly for use in the production of such diverse materials as steel, aluminum, glass, ceramics, textiles, ammunition and for a variety of applications in the electronic and atomic industries.

We can give you comprehensive data about the many rare earth and thorium salts available. Your technical staff may find it rewarding and profitable to take a long, thoughtful look at these unique materials, to examine their characteristics and, particularly, their potential applications to your own processes.



PLEASE ADDRESS INQUIRIES TO: **LINDSAY CHEMICAL COMPANY**

276 ANN STREET, WEST CHICAGO, ILLINOIS

For more information, turn to Reader Service Card, Circle No. 379

Design data on adhesives

NUMBER ONE

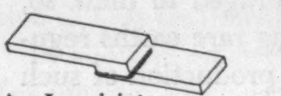
Armstrong
ADHESIVES • COATINGS • SEALERS
. USED WHEREVER PERFORMANCE COUNTS

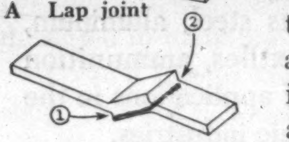
How to design joints for adhesives

Many common joints can be re-designed to give maximum strength with adhesives. The examples shown do not cover every situation, but they do illustrate how four basic design rules can be applied to improve strength. These rules are:

1. Make the bonded area as large as possible.
2. Make the maximum proportion of bonded area contribute to strength.
3. Stress the adhesive in the direction of its maximum strength.
4. Minimize stress in the direction in which the adhesive is weakest.

Strengthening a lap joint:

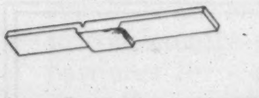

A Lap joint



B Lap joint under stress

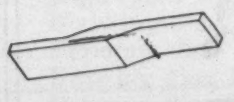
Under stress, a common lap joint such as "A" tends to deflect as the assembly aligns itself. Instead of a simple shear stress, the joint in effect more nearly resembles drawing "B". The tension effect at edges "1" and "2" tends to peel the bond apart, since a high proportion of the load is carried at the edges of the lap.

Remedy
Joggle lap (better)



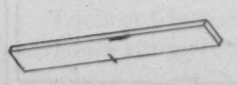
Greater proportion of bonded area now contributes to strength. (Rule 2) Stress is now reduced in the direction in which the adhesive is weakest. (Rule 4)

Beveled lap (better)



Even greater proportion of bonded area now contributes to strength. (Rule 2) Stress is further minimized in the direction in which the adhesive is weakest. (Rule 4)

Scarf (best)



Maximum proportion of bonded area now contributes to strength. (Rule 2) Adhesive is now stressed in the direction of its maximum strength. (Rule 3) Stress is now minimized in the direction the adhesive is weakest. (Rule 4)

Production line application of adhesives

It is as important to choose the right method of applying the adhesive as it is to select the proper adhesive.

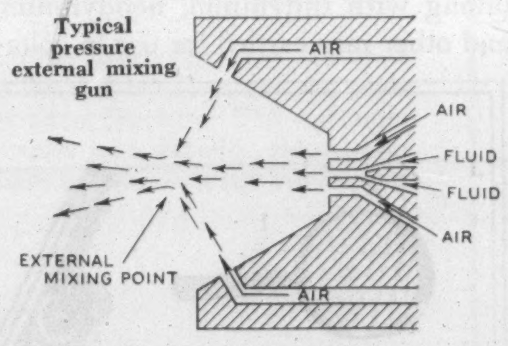
A straight-line manufacturing process with parts handled by a mechanical conveyor obviously is the most desirable setup. The adhesive is applied at the first stage, the adhesive film prepared for bonding in the second stage, and the application of pressure, if necessary, in the third stage.

The methods of application most suitable to straight-line production are spraying and roller coating.

1. Spray coating

Spray coating offers the same advantages for adhesives as for paints. Adhesives ranging from water-thin resins to viscous synthetic rubber products and even abrasive-filled materials are applied in this manner.

Some adhesives and coatings may be applied as an even, perfectly smooth film. Materials of this type should be sprayed with a pressure type (not suction) external mixing gun. The intermediate nozzle or fluid opening sizes ordinarily used for paints will control the amount of fluid ejected into the air stream, so that all of the fluid is "atomized." Fast-drying adhesives, particularly those based on synthetic rubber, cannot be applied with paint smoothness, but will spray with uniformity in almost any thickness desired. Selection of the correct air gap and fluid opening is important. Large fluid openings are better with viscous adhesives, but only if air pressure can be increased proportionately. With synthetic rubber type adhesives, higher air pressure is usually needed for breakup of the fluid stream.



Adhesives of this type can be improved by lowering the viscosity by dilution, using the recommended solvent. In using an adhesive that has been severely thinned, it must be remembered that solids content is low.

In many applications, the speed and economy offered by automatic spray equipment will quickly repay the investment required. Where the nature of the work requires hand spraying, some of the more important points are: hold the gun no more than 7" or 8" from the work; "trigger" the gun at the end of each pass rather than attempt to operate the gun continuously; hold the gun at right angles to the work to insure uniform film thickness.

2. Roller coating

Where continuous production runs of sheets of one thickness are involved, roller coating is fast and economical.

If properly compounded, most water base adhesives will roller coat on standard equipment.

Fast-drying adhesives of the synthetic rubber type require slight machine modification and a different technique. Most solvents for adhesives will attack rubber or plastics so that metal rolls must be used throughout. Synthetic rubber adhesives tend to adhere to the applicator roll and will not apply uniformly from a smooth-surfaced roll. To remedy this, the roll should contain "reservoirs" for the adhesive and enough surface irregularity to prevent suction. This may take the form of grooves at right angles to the roll axis or small cups engraved on the roll. In either case, the area between the grooves or the cups should be cross-hatched or broken up in some way. The amount of adhesive applied is determined by the depth of the machined "reservoirs" and their spacing.

While the coater is in use, the adhesive should be prevented from losing solvent by evaporation, which increases viscosity. To do this, the adhesive should be fed to the pan continuously at the used rate. The pan should be covered or the adhesive stirred in the pan for uniform feed to the take-up roll. Production should be as nearly continuous as possible.

For more information on adhesives—and design problems involving adhesives—write for a copy of "Armstrong Adhesives, Coatings, and Sealers." Armstrong Cork Company, Industrial Div., 8006 Dunbar St., Lancaster, Pa.

For more information, turn to Reader Service Card, Circle No. 436

CORNING GLASS

BULLETIN FOR PRODUCT DESIGNERS

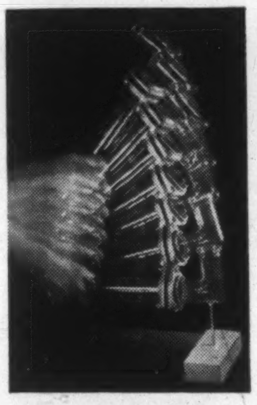
CORNING GLASS WORKS, 50-6 Crystal Street, Corning, New York
Please send me the following material:
☐ Booklet: "Glass and You."
☐ Bulletin IZ-1: "Glass . . . its increasing importance in product design."
☐ Information on the VYCOR brand glasses.
Name__________
Title__________
Company__________
Address__________
City__________Zone__________State__________

How to engineer a platypus

A happy combination of purposeful practicality is the furry platypus with its webbed feet, beaver's tail, and duck's bill.

A lot of our customers, to their continuing delight and profit (we hope), have discovered that glass is sort of platypus-like in that it, too, can be made to combine many useful characteristics.

Take, for example, PYREX brand pipe. Here you see a man using a piece of it to drive a one-inch nail in a pine block. This is essentially an extra-curricular activity for glass pipe, which is more at home conveying metal-eating acids around chemical plants, but it's a way of showing just how tough glass can be when it's *made* that way.

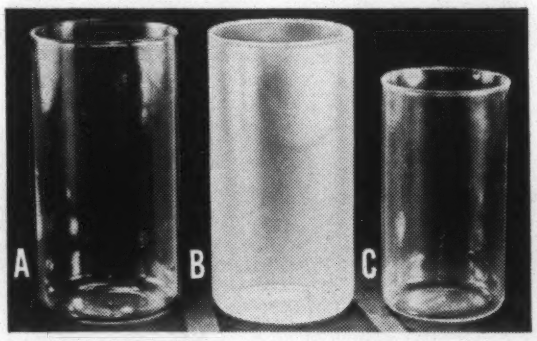


All of which may serve to illustrate for you how we can arrange the optical, chemical, thermal, mechanical, and electrical properties of glass in different combinations to match a considerable variety of end-use requirements. In fact, we've worked up some 50,000 different formulas for glass in our years of helping customers solve specific design and processing problems.

If platypus-like glass is a novel idea to you, if you've never given glass a second thought as a highly adaptable design and construction material, we suggest your reading a pocket-size volume entitled "Glass and You." It tells in a few words and many pictures how glass contributes to profit and pleasure and we'd be delighted to send you a copy. Or, if you're more concerned with putting glass to work for you than in learning what it's doing for others, there's a slightly more technical bulletin called, "Glass—its increasing importance in product design." We'll be glad to send you either—or both.

Most remarkable glass

In 1952 Philadelphia's Franklin Institute presented the John Price Wetherill Medal to Corning's Dr. Martin E. Nordberg and Harrison P. Hood for inventing the most fabulous of glasses—VYCOR brand 96 per cent silica glasses.



Evolution of a VYCOR jar: A—formed by conventional glass blowing; B—"thirsty glass"; C—finished product.

These two scientists discovered a composition that appeared to be a combination of two distinct types of glasses. One type could be dissolved out, leaving a skeleton of 96 per cent or more of silica filled with so many millions of holes that a one-inch cube contained some 60,000 square feet of hole surface.

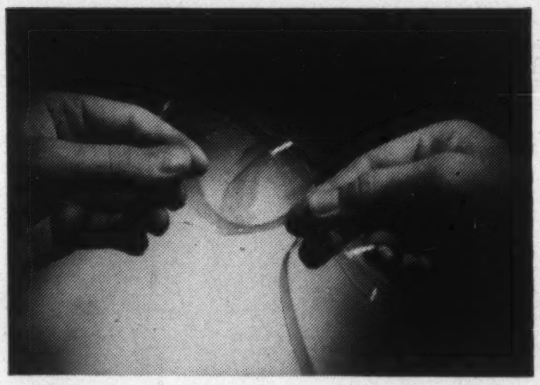
This new child of research was dubbed "thirsty glass" because, just sitting around, it absorbed moisture right out of the air. But our researchers were on the trail of something even more exciting. They heated their "thirsty glass" and it shrank to two-thirds its original size. The millions of little holes vanished and left a vacuum-tight glass that looked like any other—except that you could take this new glass white-hot from a blazing furnace and plunge it into ice water without the slightest injury. It was a glass as ideal as fused quartz, but different since it could be melted, mass produced, and worked in its original state like ordinary glass.

If you'd like to know more, just check the coupon above.

Ribbon glass by the yard

Here's a glass that's a thousandth of an inch thin and in small widths it's flexible as—well, a ribbon. You can twist it, roll it, wrap it around your arm without cracking it. It comes in any length you want—inches, yards, miles.

Actually ribbon glass isn't a single glass. We can make it of several different compositions according to what you need it for. Originally we developed it to take the place of mica in electronic capacitors of which there are several in your radio and TV sets and in any other piece of electronic equipment you can name. As mica is formed in layers, it is subject to cleavage in the plane parallel to lamination; ribbon glass being homogenous is easily workable. This is just one advantage of this glass in capacitors.



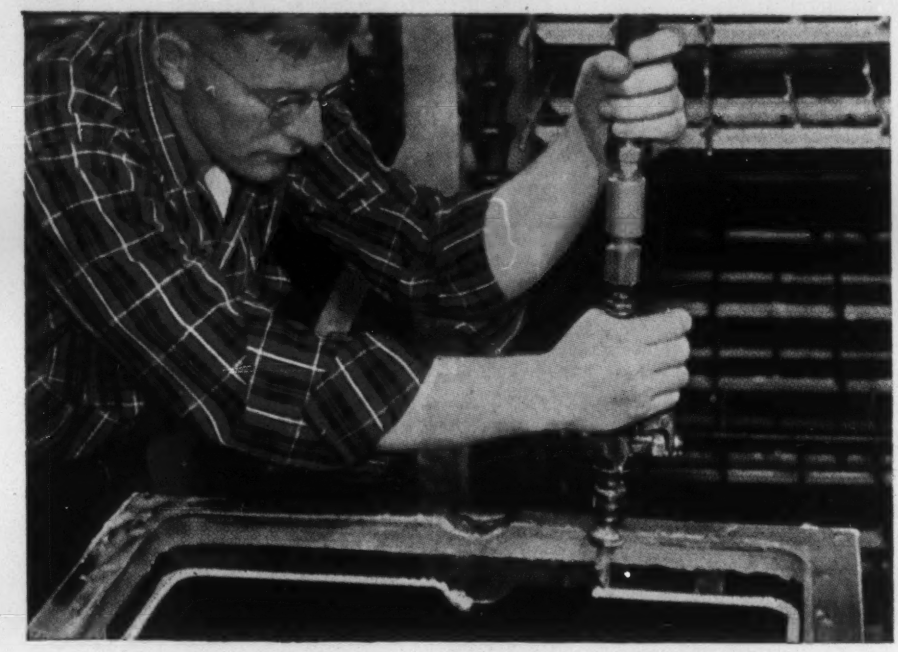
Medical scientists have found a quite different use for ribbon glass—as microscope slide covers. These are the wafer-like pieces of glass that are used to cover blood smears and the like for examination under the microscope. In this case ribbon glass can be made clearer, flatter and more free of bubbles and striae than previously made glasses.

Seems as if this unique stuff should be good for a *lot* of things, but *what* (other than electrical and laboratorial) probably lies in the laps of imaginative designers. Would you like us to send you a little strip to play with? *Customer* ideas and problems really bring out the best in glass. So, even if what's on your mind seems unrelated to any item this page discusses, glass may still be its fulfillment. We'd like to hear from you.

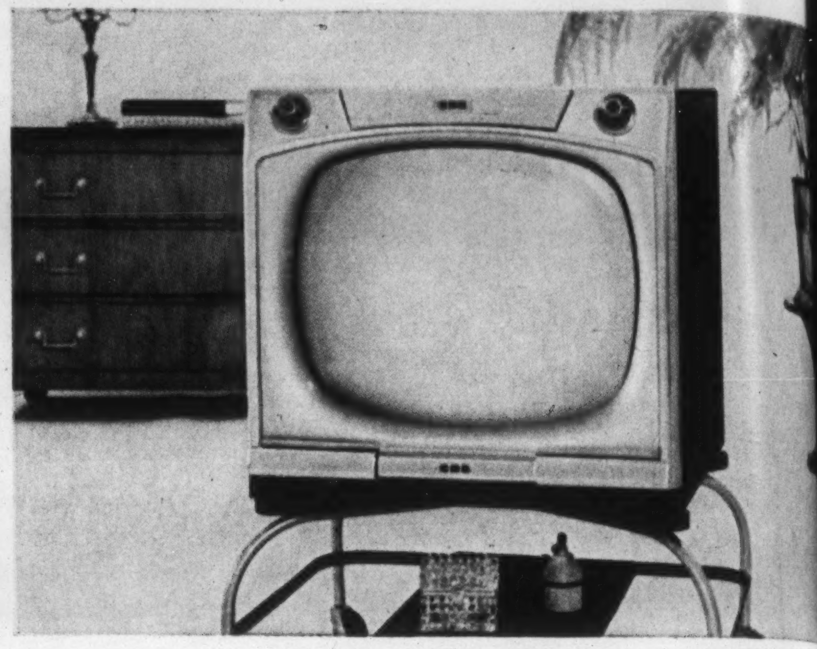
CORNING GLASS WORKS
CORNING, N. Y.
Corning means research in Glass

For more information, turn to Reader Service Card, Circle No. 409

GASKETS THAT FLOW ANYWHERE, then can be foamed and fused in place to give tough, tight seals at great savings in time and labor, are made of plastisols based on **PLIOVIC.**



FINISHED BEFORE IT WAS FORMED, this beautiful television cabinet won chip, crack or craze, defies abuse, abrasion and age. It's made of sheet PLIOV laminated to metal.



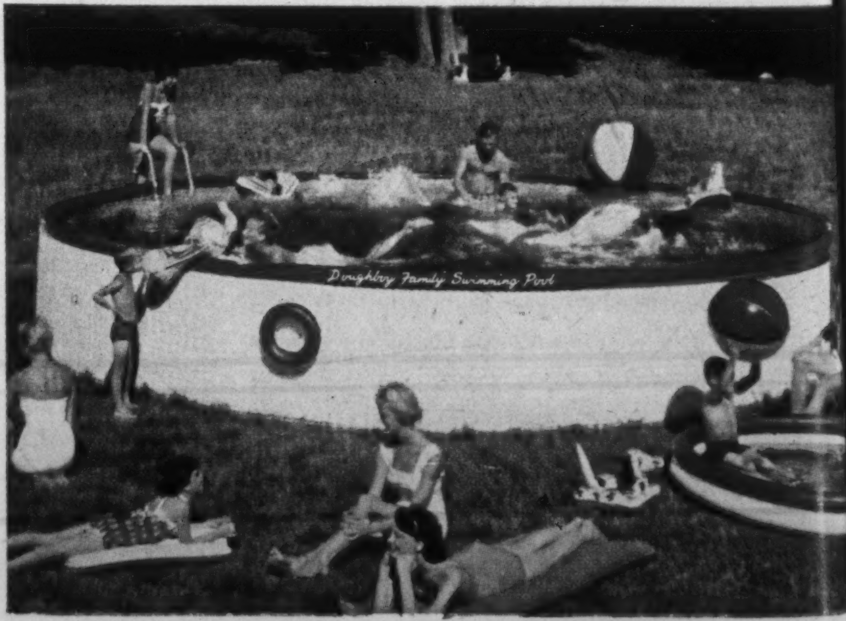
EW KIND C
bber sheets
to 20 tim

What do Flowable Gaskets, Flying Wa

WALLS THAT FLY are these attractive panels of calendered **PLIO-TUF** for aircraft interiors. They are strong, light in weight and highly resistant to impact at low temperatures.

TRUE MEASURE OF QUALITY AND QUANTITY is offered by this pump with liquid end molded of impact- and chemical-resistant **PLIO-TUF.** Unique construction permits the accurate metering of the most corrosive liquids and slurries.

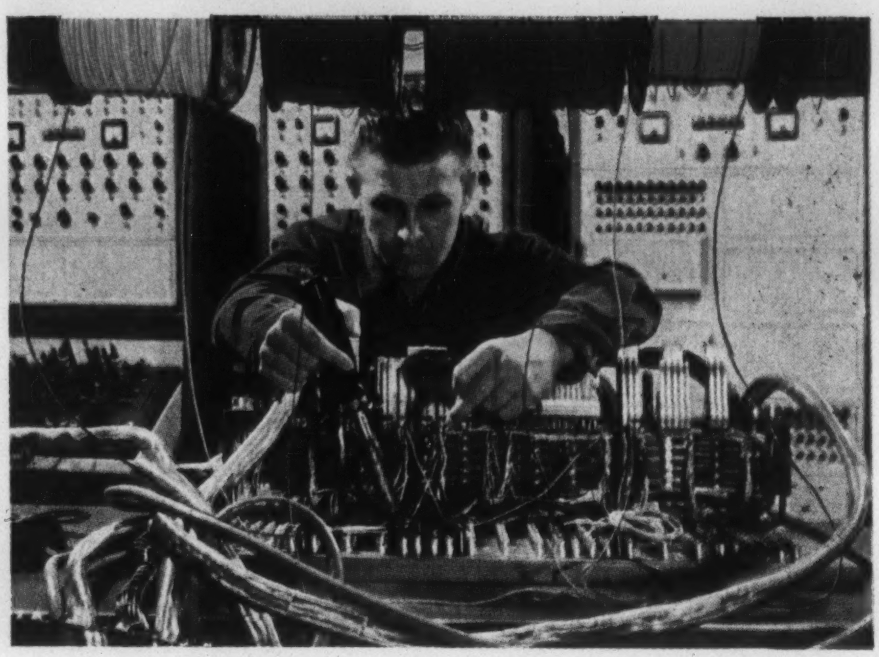
CRYSTAL-CLEAR SHOWCASES for soft goods are made from tough, transparent film of blown **PLIOVIC.** It is easily heat-sealed to form dust-free package—resists roughest handling.



KING-SIZED KIDDIE POOL lets whole family swim in backyard. It's made of heavy-duty **PLIOVIC** sheeting for high strength and resistance to water, sunlight, hard wear and age.

EW KIND OF CARPET consists of thin sheet of PLIOVIC laminated to heavier bber sheets. Brightly colored and easy cleaning, it outwears all-rubber mats p to 20 times over.

COLORFUL CLUES for assemblers and users of electronic computers are supplied by wire coverings extruded from PLIOVIC. They provide excellent insulation—are extremely durable.



ng Walls and Prefinished Cabinets have in Common?

Here are eight products that differ widely in appearance and application. But they do have something in common: Each was made possible by raw materials and services offered by the Plastics Department of the Goodyear Chemical Division.

The materials involved are PLIOVIC and PLIO-TUF. PLIOVIC is the family name for a series of easy processing vinyl resins. PLIO-TUF is the name for a family of high impact styrene resins. They are materials designed to keep pace with the progress constantly being made by the plastics industry.

The services involved range from those of strategically located sales offices and warehouses to well-equipped service laboratories to modern production plants to extensive research facilities. All are staffed by specially trained, experienced personnel to meet the demand for increasingly specialized technical service.

The Plastics Department is new, yet not new. It results from a recent reorganization designed to give customers of the Chemical Division the ultimate in service and quality. It combines experience with the verve and vitality of a new organization well equipped to make its mark in a highly competitive market.

Why not learn how the new Plastics Department can give your present or potential product something in common with those shown here—success! You can, simply by writing and asking for help to: Goodyear, Chemical Division, Dept. R-9437, Akron 16, Ohio.

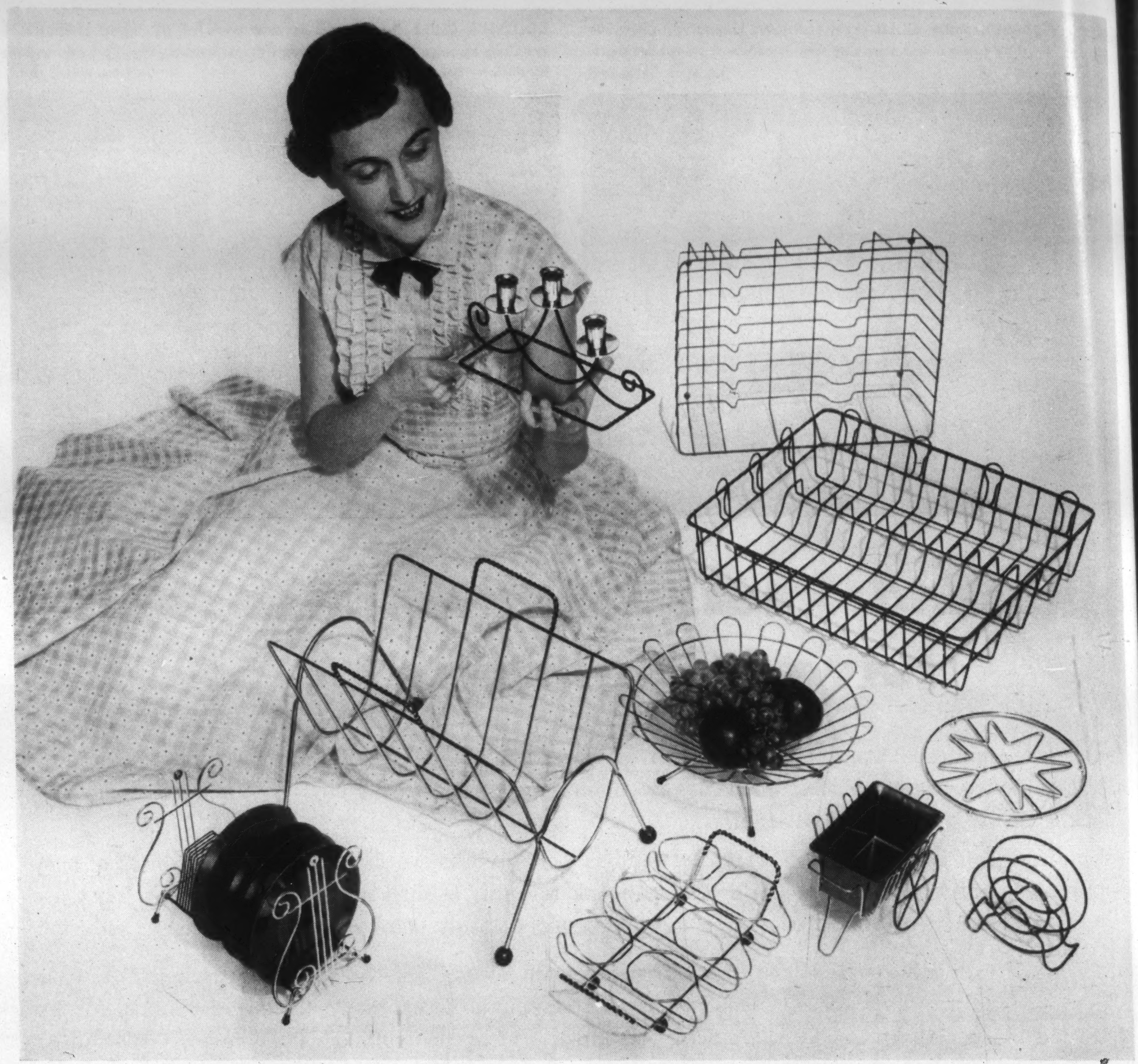
Chemigum, Plioflex, Pliolite, Plio-Tuf, Pliovic—T.M.'s
The Goodyear Tire & Rubber Company, Akron, Ohio

CHEMICAL
GOODYEAR
DIVISION

PLASTICS
DEPARTMENT

Plio-Tuf
high impact plastic
PLIOVIC
vinyl resin

CHEMIGUM • PLIOFLEX • PLIOLITE • PLIO-TUF • PLIOVIC • WING-CHEMICALS
High Polymer Resins, Rubbers, Latices and Related Chemicals for the Process Industries



These eye-catching products are proof that steel wire can be prettied up. The candelabra and the wire dividers of the record "caddy" are finished in black bonderite, while the remaining items are plated with lustre-bright brass.

Handsome Housewares from Bethlehem Wire

These and other attractive housewares are made by Artistic Wire Products Co., Inc., East Hampton, Conn., from steel wire which we have been supplying for about nine years. A leading manufacturer of kitchen and houseware specialties, Artistic requires a wire having a surface suitable for spot-welding and plating.

Their multiple electro-welding machines call for wire with a minimum of surface irregularities. After welding, they finish the wire with black bonderite or with metal-plating, depending upon the product. Their "Vinylmaid" line of dish drainers and other specialties are coated with vinyl plastic in popular colors to match the modern kitchen.

A big part of our job is working closely with wire users, developing the best type of wire for each different application. Whether you need one of our special-purpose wires or one of the more ordinary types, you can count on our modern wire mills to do the kind of job that will keep your steel wire problems to a minimum.

Perhaps our wire-making experience can be of help to you right now. Just phone the nearest Bethlehem sales office or write to us at Bethlehem, Pa.

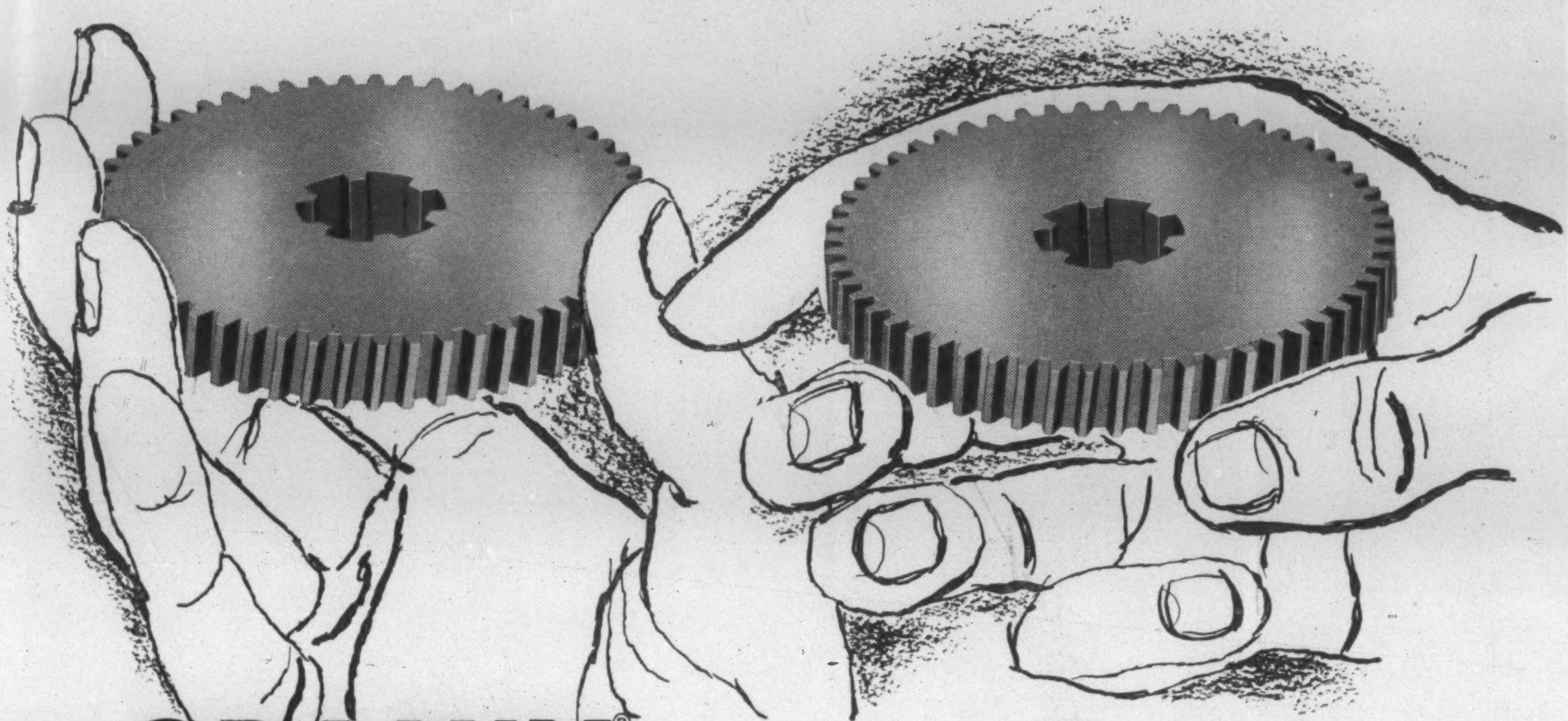
BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by
Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

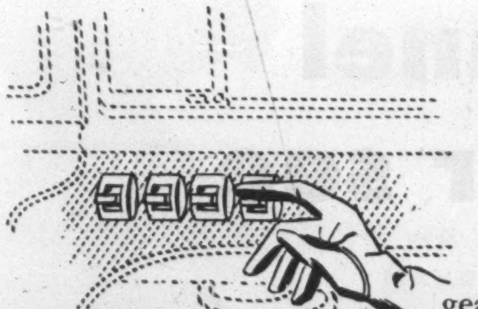
BETHLEHEM STEEL

For more information, turn to Reader Service Card, Circle No. 425

which helical gear costs 80% less?



the GRAMIX® sintered metal helical gear performs better than a forged and hobbed aluminum part for just 1/5 the cost!



114

By replacing forged aluminum gears with sintered steel GRAMIX helical gears, a manufacturer of automotive equipment found that he could realize an 80% saving and get greater dependability. The gear is a component of an automatic window raising and lowering mechanism currently being used by four different automobile manufacturers. The helical teeth are formed in the compacting dies, and, after sintering, the GRAMIX gear is ready for assembly into the power window unit . . . there is no need for costly machining or time-consuming finishing operations like the hobbed aluminum gear used previously. In spite of the astonishing savings, these GRAMIX gears have proven to be even better than the former forged gear from a standpoint of toughness and wearability.

GRAMIX metallurgists can provide the exact alloy for your design specifications. GRAMIX parts may be oil-impregnated for self-lubrication. They seldom need machining, and will often outlast similar machined parts. Complex shapes can be produced to tolerances as close as .0005″. Whatever your requirements may be, it will pay you to investigate GRAMIX.

Do you have our big detailed GRAMIX catalog? . . . write today for your copy.

GRAMIX
THE UNITED STATES GRAPHITE COMPANY

THE UNITED STATES GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN

For more information, turn to Reader Service Card, Circle No. 567

Tunnel within a tunnel — 8500 ft. exhaust ducts along the top of each Holland Tunnel tube are supported by seven-foot Monel hangers. There's one every eight feet along the duct.

The Holland Tunnel that drivers never see

Drivers never see *this* tunnel because it is hidden above the ceiling—*a tunnel within a tunnel.*

It's part of a unique air exhaust system that completely changes the air in the Holland Tunnel every minute and a half. Since the famous tunnel connecting New York and New Jersey was opened in 1927, the system has proved so successful that designers of the Lincoln and other large tunnels have adopted it.

In working out this unusual exhaust system, Port of New York Authority engineers faced the problem of providing support for the tunnel ceiling, or — more correctly — the "exhaust duct floor." In order to minimize wind resistance, hanger rods from the tunnel shell to the duct floor had to be as thin as possible.

The answer — Monel nickel-copper alloy!* The strength of Monel alloy — plus its corrosion resistance — enabled the engineers to use hangers of minimum cross-section without requiring any allowance for corrosion.

A recent check showed these thin Monel hangers in as good condition as when installed. *No corrosion after 28 years, despite dampness and the high concentration of corrosive engine fumes in the exhausted air!*

When you have a metal problem, one of the Inco Nickel Alloys may be the answer to it. These alloys are all strong and tough. They can help you reduce weight . . . protect product purity. They can provide improved resistance to corrosion . . . or greater ability to withstand heat.

Write for "Standard Alloys for Special Problems." This booklet summarizes the properties, applications and available forms of all the Inco Nickel Alloys. You'll find a copy helpful in selecting the right metal for *your* job.

And, of course, we're always glad to work with you on problems. Don't hesitate to call us in.

*Registered trademark

Nickel Alloys Perform Better Longer

INCO TRADE MARK

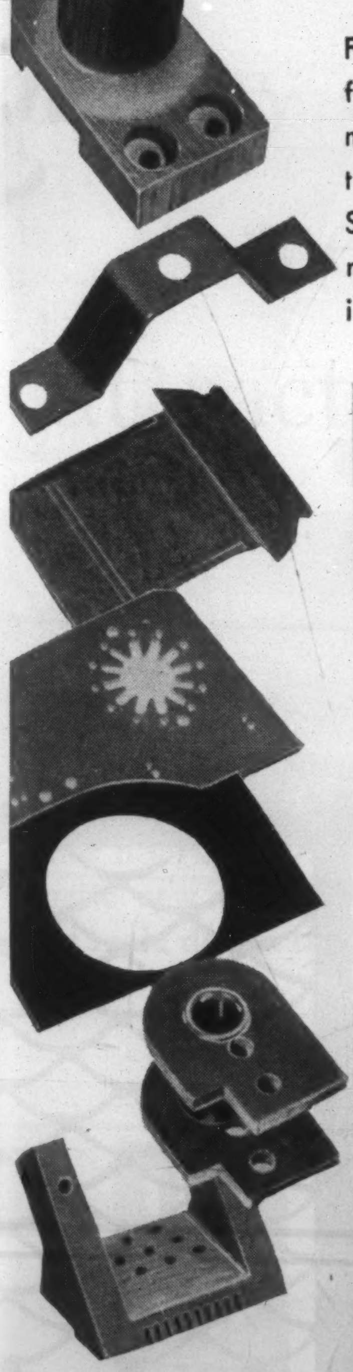
THE INTERNATIONAL NICKEL COMPANY, INC.

67 Wall Street New York 5, N. Y.

For more information, turn to Reader Service Card, Circle No. 371

MADE BY Spaulding

FOR ORIGINAL EQUIPMENT MANUFACTURERS IN ALL INDUSTRIES



Fabricated to exact customer specifications from Spaulding's own widely adaptable basic materials, these parts and components are typical of the countless varieties that Spaulding supplies to original equipment manufacturers in almost every conceivable industry.

Contact the Spaulding Sales Office in your area to investigate the amazing possibilities which Spaulding's Vulcanized Fibre, Laminated Plastics and other materials hold for the products **you** manufacture or design. It's likely you'll find that Spaulding can help you cut cost and improve quality in your original equipment production.

THE PROPERTIES OF SPAULDING MATERIALS INCLUDE Great mechanical strength, extremely light weight, durability, chemical inertness, excellent machinery qualities, arc resistance, deionizing ability and low loss electrical insulation.

WE MAKE AND FABRICATE

VULCANIZED FIBRE: In sheets, rods, tubes and fabricated parts.

ARMITE: Thin Insulation (Fish Paper) in sheets, rolls, coils and fabricated parts.

SPAULDITE: (Laminated Thermosetting Plastic) in sheets, rods, tubes and fabricated parts.

SPAULDO: Motor Insulation in sheets, rolls, coil, slot cells and other fabricated parts.

SPAULDING FIBRE BOARD: In sheets and fabricated parts.

SPAULDING T BOARD: A superior Transformer Board in sheets and fabricated parts.

MATERIALS HANDLING EQUIPMENT: Factory Trucks, Boxes, Barrels, Trays, etc.

SPAULDING FABRICATING FACILITIES: Spaulding's fabricating facilities for these products are unsurpassed the world over. You can save time and money by letting us do your fabrication. We'll be glad to quote on specific jobs without obligation.

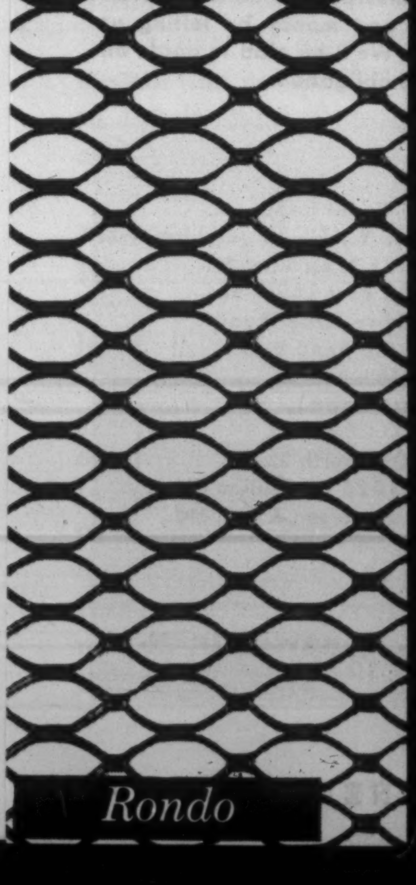
SPAULDING BRANCH SALES OFFICES

Baltimore 18, Md., 123 West 22nd St.
Boston 16, Mass., 585 Boylston St.
Boston Area:
Wellesley Hills 82, Mass., 44 Washington St.
Bridgeport 5, Conn., 2889 Fairfield Ave.
Camden 1, N. J., 227 South Sixth St.
Chicago 25, Ill., 4770 Lincoln Ave.
Chicago 38, Ill., 5604 West 63rd St.
Cleveland 14, Ohio, 2108 Payne Ave.
Cleveland 16, Ohio, 19035 Detroit Rd., Rocky River
Dayton 2, Ohio, 136 So. Ludlow St.
Detroit 1, Mich., 4612 Woodward Ave.
Fort Wayne 6, Ind., 2301 Fairfield Ave.
Lansing 10, Mich., 2021 South Cedar St.
Woodhaven 21, L. I., N. Y., 90-34 Jamaica Ave.
Milwaukee 8, Wisc., 3329 West Vliet St.
New York 55, N. Y., 384 East 149th St.
St. Louis 5, Mo., 7247 Olive Street Road
St. Louis 17, Mo., 1500 Big Bend Blvd.
Tonawanda, N. Y., 310 Wheeler St.
Westfield, N. J. (Newark Area), 101 Central Ave.
Berkeley 10, Calif., 2221 Fourth St.
Los Angeles 15, Calif., 1325 San Julian St.
Toronto 18, Ont., A. A. Andersen & Co., Ltd., P. O. Box 92

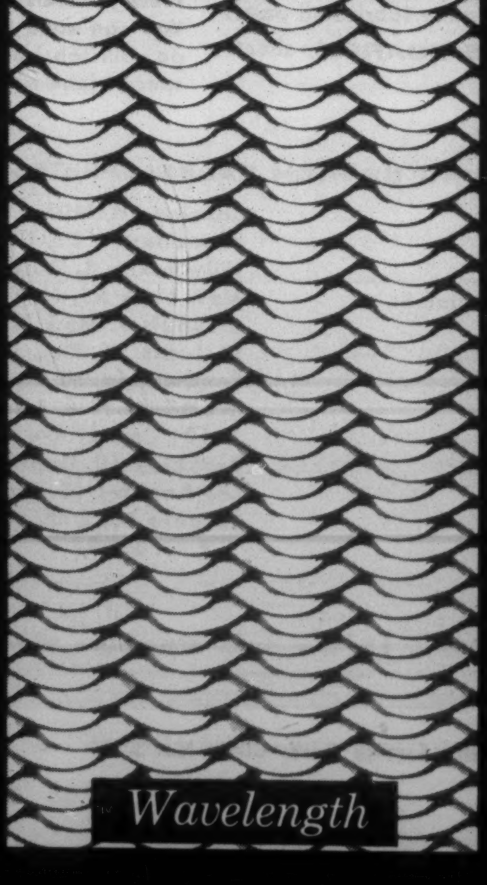
SPAULDING FIBRE CO., INC. 310 Wheeler Street, Tonawanda, N. Y.

• For more information, turn to Reader Service Card, Circle No. 501

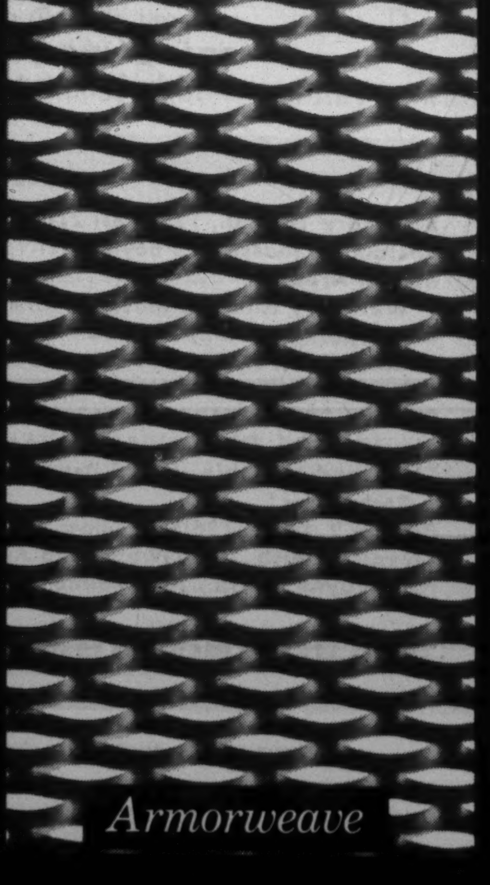
expanded METAL



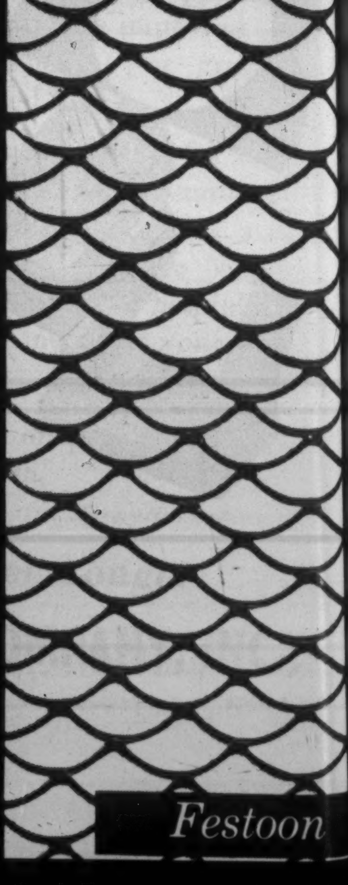
Rondo



Wavelength

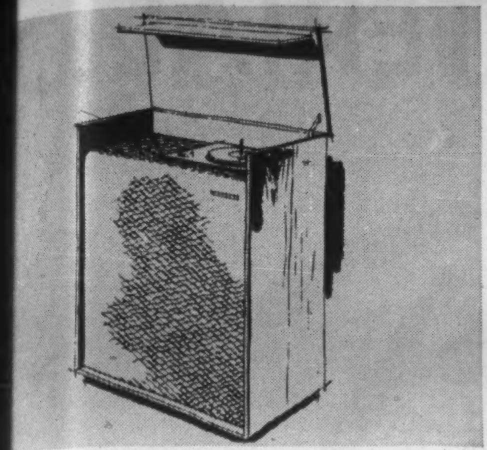


Armorweave

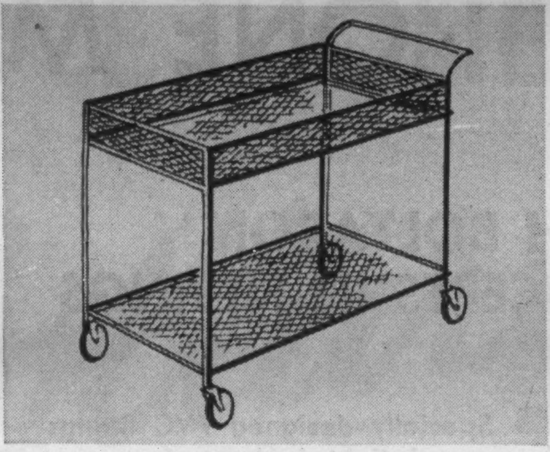


Festoon

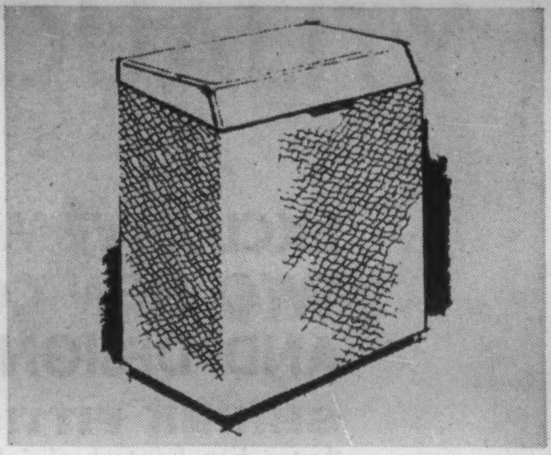
TH EXPANDED METALS . . . HORIZONS ARE EXPANDING FOR DESIGNERS IN MANY FIELDS



sign of countless products will be cted by these inspiring new meshes. erently strong and artistically pleasing, se metals contribute to the life and pracility of products . . . combine function h beauty for greater sales appeal.



Strength without excessive weight opens doors to design possibilities without limit, makes less metal do more work for you. U.S.G. Expanded Metals are readily fabricated and formed, do not ravel in cutting, and may be welded without difficulty.



Open mesh design of U.S.G. Expanded Metals permits free passage of light and air. Because of its strength, frames and other supports can often be eliminated. Designers may combine painted or anodized meshes with colored fabrics or other materials.

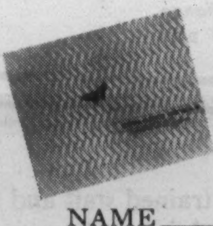
o carry out your ideas...in new meshes that are lighter, more attractive, stronger than solid sheets

A new expression . . . for everyone concerned with design, manufacture and sale of products for better living! Four new U.S.G. Expanded Metals—RONDO, FESTOON, WAVELENGTH and ARMORWEAVE—join long-popular EXPAND-X*, to offer design possibilities unlimited. These dramatic new meshes, versatile enough to carry the main design theme or to serve as ornamentation, promise quick and widespread acceptance of products that utilize their beauty and charm. Cold-drawn from a solid sheet of metal—aluminum, or carbon steel, and, in some meshes, stainless steel—these new expanded metals are strong and rigid, yet lightweight and easy to fabricate. Whatever your product, U.S.G. Expanded Metals will help to make it *better*.

UNITED STATES GYPSUM

pioneering in ideas for industry

*T.M. Reg. U.S. Pat. Off.



MAIL COUPON TODAY!
United States Gypsum, Dept. MM-1
300 W. Adams St., Chicago 6, Ill.
Please send free booklet—"THE SHAPE OF THINGS TO COME" —all about these new metals and the future of design.

NAME______________________
COMPANY______________________
ADDRESS______________________
CITY____________ZONE______STATE______

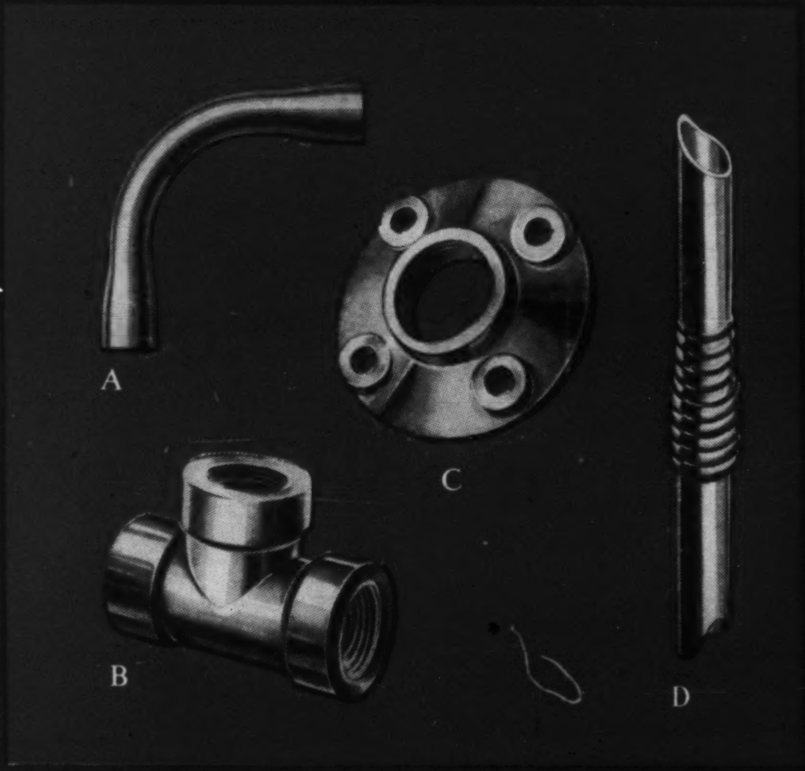
For more information, turn to Reader Service Card, Circle No. 492

ONE MATERIAL . . .

EXCLUSIVE WITH BOLTARON TWO NEW CONCEPTS IN FITTINGS AND DESIGN!

SHRINK FITTINGS Specially designed PVC fittings that, when heated, shrink to form an air-tight, leak proof, permanent mechanical bond insuring a non-corrosive, free-flow piping system.

ROLL-THREAD DESIGN Specially engineered PVC pipe that, through the use of a roll thread, forms a mechanical bond better than conventional threading for larger sized pipe. Available in 3", 4", and 6" diameters. Quick and easy installation.



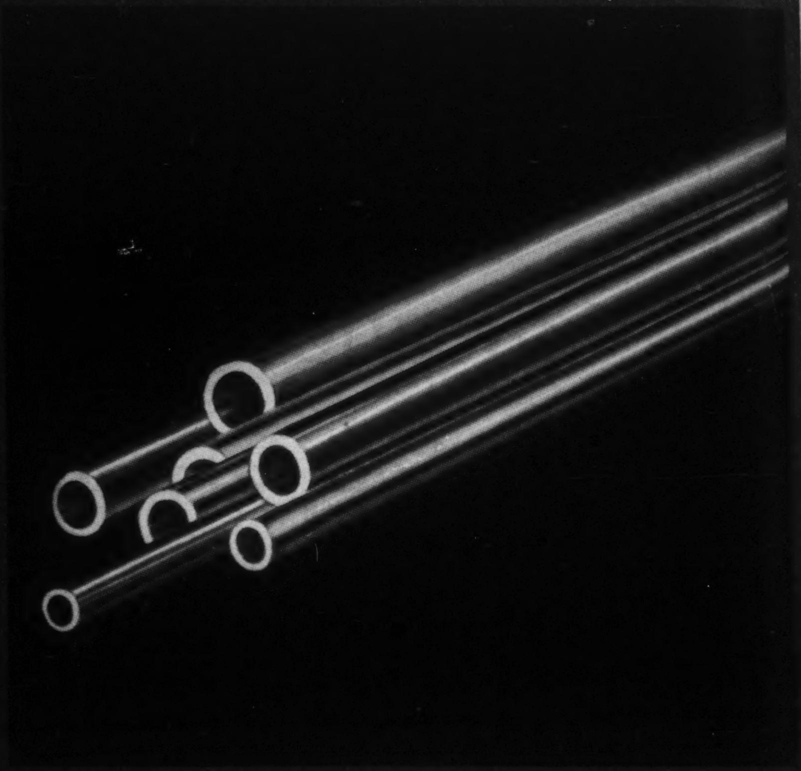
FITTINGS

Boltaron offers you the only complete line of PVC fittings in a full variety of sizes. The line includes ells, tees, plugs, caps, couplings, bushings, unions, flanges and expansion joints in standard pipe threads and, in most cases, the new shrink fitting and roll-thread design. All molded standard threaded fittings are produced by Stokes Molded Products.

All Boltaron fittings are made of Boltaron 6200 unplasticized PVC and are manufactured under rigid inspection standards. This assures you of uniformity of quality and maintenance-free, corrosion-free action in your PVC installations.

A. Shrink-fitting ell*
B. Threaded tee
C. Standard flange
D. Roll-thread pipe

* Patent applied for



PIPE

A complete line of PVC pipe from ¼" through 6" in Schedules 40 and 80. Only one-sixth the weight of steel, Boltaron 6200 pipe offers easy handling and quick installation.

Like other Boltaron 6200 PVC products, it has outstanding resistance to corrosive gases and liquids, treated and untreated waters, alcohols, alkalies and acids; it's a non-conductor, thus eliminating electrolysis problems. It's abrasion-resistant. Boltaron PVC pipe virtually eliminates maintenance.

TECHNICAL SERVICE: Our highly trained staff and that of our distributors and fabricators are located throughout the country to give you expert advice and service. They will advise you on the complete Boltaron 6200 unplasticized PVC line at no obligation.

TRAINING SCHOOL: The Plastic Fabricating Institute, located in Lawrence, Mass. and organized by H. N. Hartwell and Bolta Products is available to your personnel. Training is given to fabricators, distributors, piping contractors and industry in the application, fabrication, welding and forming of Boltaron 6200 unplasticized PVC.

...ONE SOURCE...ONE QUALITY

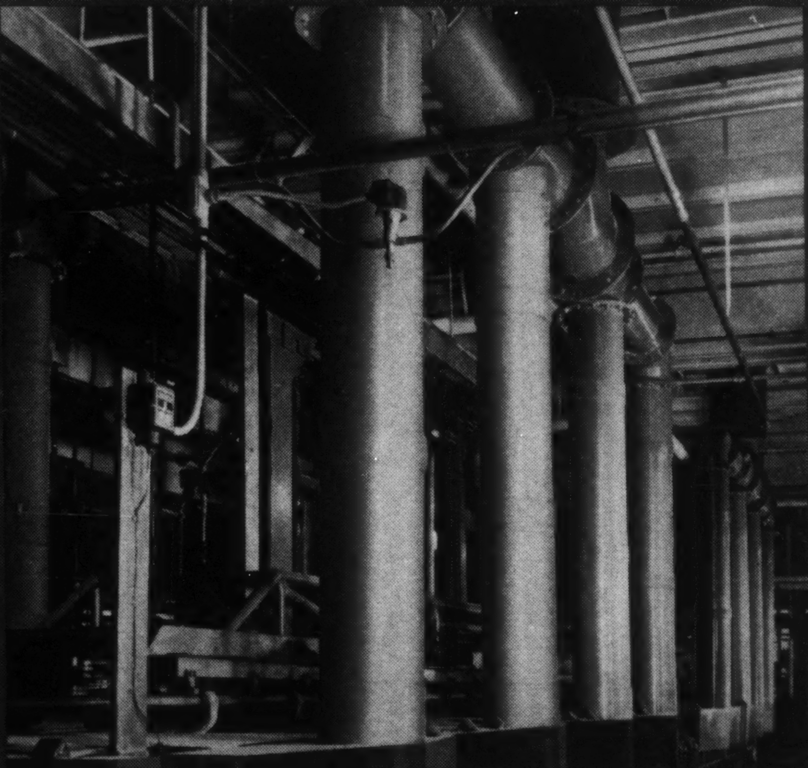
Boltaron 6200

Registered Trademark, The General Tire & Rubber Co., Akron, Ohio

unplasticized PVC (type I)

THE ANSWER TO YOUR CORROSION PROBLEMS

LUNKENHEIMER



VALVES

Boltaron PVC valves, engineered by Lunkenheimer, are the first all-molded unplasticized PVC valves designed and engineered by a valve manufacturer. Boltaron valves are available in ½" through 2" sizes. Component parts are made of Boltaron 6200 PVC, insuring complete corrosion-free service.

Boltaron 6200 is odorless, tasteless and resistant to industrial chemicals. Weighs only ½ as much as aluminum and can be molded to precise tolerances.

CUSTOM APPLICATIONS

Boltaron 6200 unplasticized PVC is available in corrosion-resistant pipe, rod, sheet and block form. Its handling versatility is unique. To fit your particular needs, Boltaron can be stamped, sheared, sawed, ground, turned and milled; it can be planed, drilled, embossed, drawn, molded, rolled, bent, heat or solvent welded. Whatever your needs — an exhaust system, acid piping or machined parts — Boltaron meets your specifications.

Our expert force of consulting engineers is at your service. Contact us — there's no obligation.

Some territories still available for fabricators and distributors

H. N. HARTWELL & SON, INC.

Industrial Plastics Division, **Park Square Bldg., Box 406, Boston 16, Massachusetts**

The only integrated source for Unplasticized PVC Materials

• **For more information, turn to Reader Service Card, Circle No. 496**

Another
Opportunity
Chemical from
General Mills

Tough, low-cost plastic to
easy to make with V

Plastic lathe fixture, left, is used to make propeller spinners at Champion Aircraft Corp.

**Investigate Versamids*
the versatile polyamide
resins made only by...

CHEMICAL DIVISION

tools and dies are Versamid*-epoxy alloys!

Strong, lightweight plastic tools have passed rigid, practical tests and are in daily use in aircraft, automotive and other industries. Champion Aircraft Company of Osceola, Wisconsin is one of many manufacturers who have found Versamid-epoxy alloy tooling economical, efficient and a valuable aid to their business. Thermosetting alloys of Versamid-epoxy resins are being used to produce aluminum and even heavy gauge steel stampings. These alloys show high impact strength, are extremely easy to work with, and can be formulated to yield almost any set of properties desired.

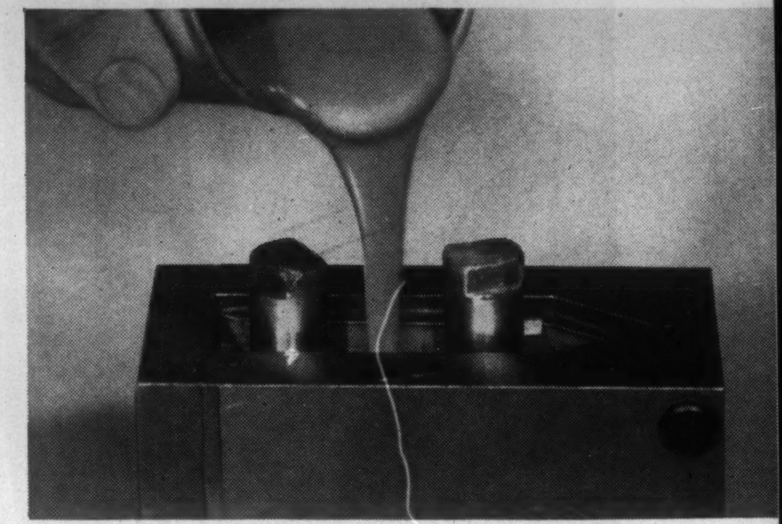
Maybe tools and dies aren't your problem, but chances are you can use Versamid polyamide resins to save time and money in other applications. Tough industrial finishes, plastic body solder, structural adhesives, rugged plastic laminates . . . these are but a few of the known and tested uses for versatile Versamids. Only Versamid polyamide resins do so many jobs so well, and only General Mills makes Versamids.

Write for free booklet. The Spring issue of General Mills magazine, *Progress Thru Research*, contains a fact-filled article on plastic tooling. If possible, name your needs for specific information on the application you're considering. Write General Mills Chemical Division, Department MM7, Kankakee, Illinois.

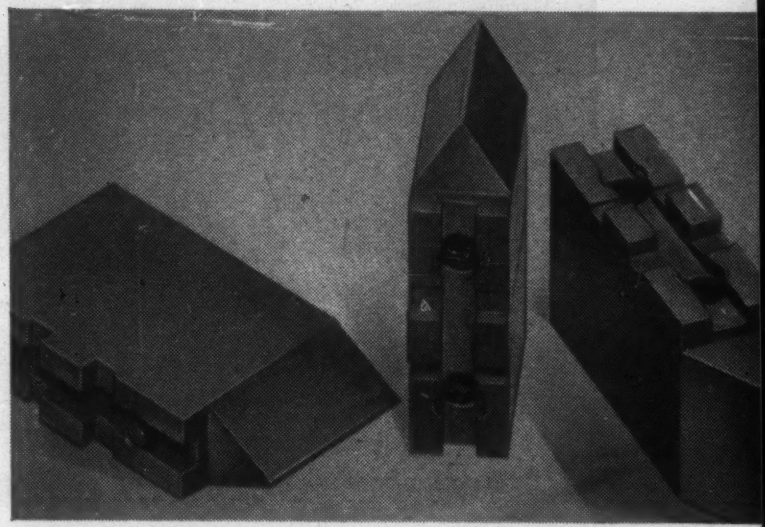
progress thru research

Please note that General Mills does not market plastic tool and die alloys . . . only the Versamid polyamide resins used in such alloys.

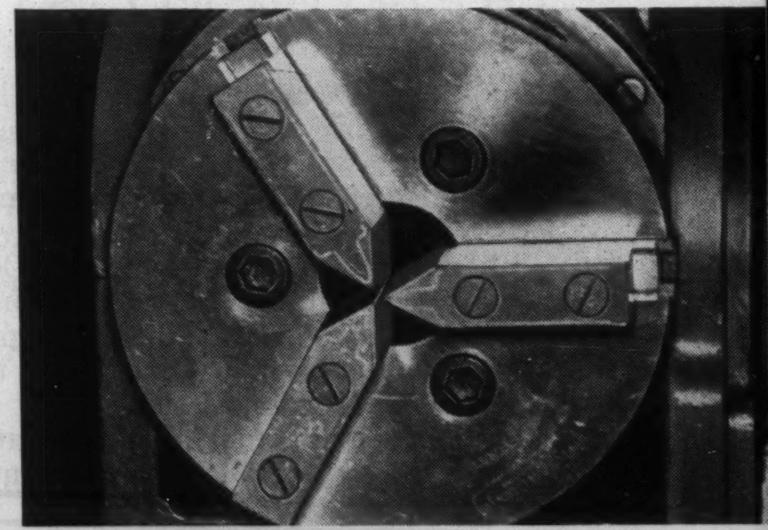
Versamids* Make Plastic Tooling Practical



1. Here an alloy of Versamid 125, epoxy resin and aluminum powder is poured into a brass mold.



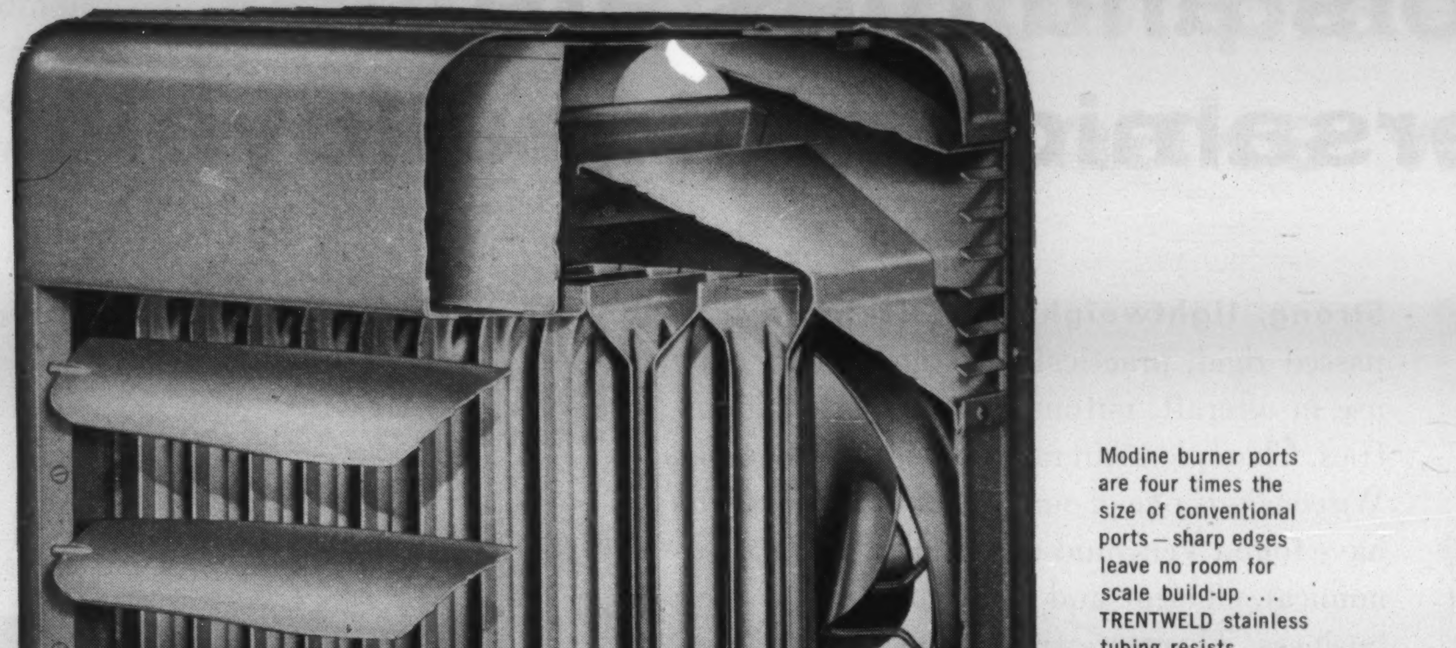
2. These soft jaws, or chucks, are molded from Versamid-epoxy alloy at extremely low cost.



3. Finished three-jaw chuck in regular use on lathe in precision machine shop.

OF **General Mills** KANKAKEE, ILLINOIS

For more information, turn to Reader Service Card, Circle No. 568



Modine burner ports are four times the size of conventional ports—sharp edges leave no room for scale build-up . . . TRENTWELD stainless tubing resists corrosion.

Shape of Modine tubes and ports assures better secondary air supply than conventional shape on right.

two-way improvement in burners with

TRENTWELD STAINLESS TUBING

Heat, humidity, combustion gases—this corrosion-breeding trio plagues industrial unit heaters. Trouble starts when rust builds up around burner ports and surfaces pick up foreign matter. As ports grow smaller . . . heating efficiency drops.

When Modine Manufacturing Company, Racine, Wisconsin, introduced their line of gas-fired unit heaters in 1951, they had approached the problem from two directions. First, they used TRENTWELD stainless steel tubing for ports and tubes. The use of stainless eliminates corrosion and scaling—despite high temperatures . . . and even during the nonheating season, when tube condensation or atmospheric moisture are troublesome.

Modine engineers also designed a radically new burner around the TRENTWELD tubing. Burner ports are four times the size of conventional drilled ports . . . and their knife-sharp edges offer no room for scale build-up. Another important Modine advantage stems from the *shape* of the stainless tubing. This gives a better secondary air supply, improves combustion efficiency.

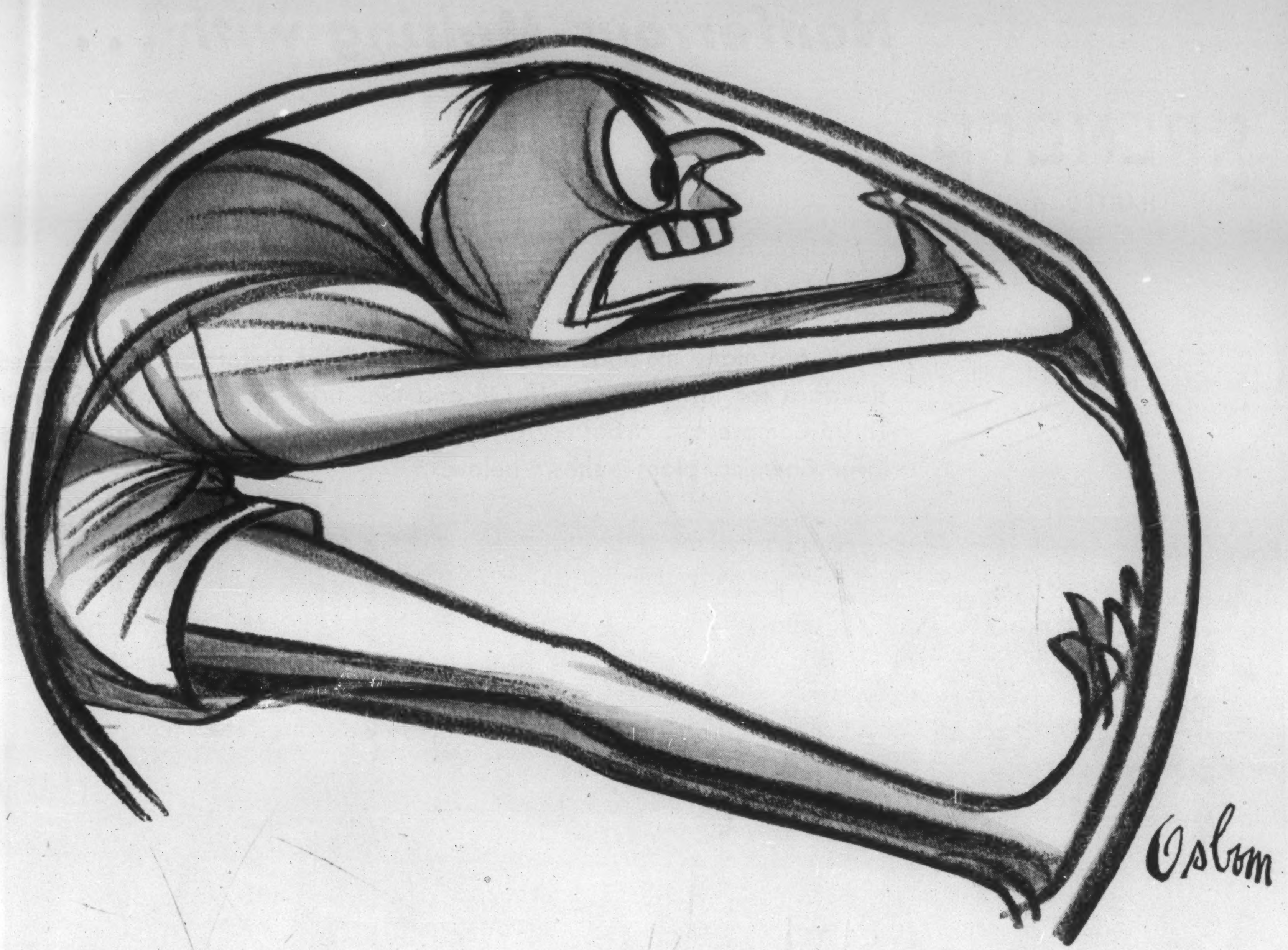
Why not see if your product, too, can benefit from the advantages of TRENTWELD stainless or high alloy tubing. Remember, they're products of tube mill specialists—you can't buy better than TRENTWELD.

TRENTWELD

STAINLESS STEEL TUBING

TRENT TUBE COMPANY, GENERAL SALES OFFICES, EAST TROY, WISCONSIN (Subsidiary of CRUCIBLE STEEL COMPANY OF AMERICA)

For more information, turn to Reader Service Card, Circle No. 502



STRESS

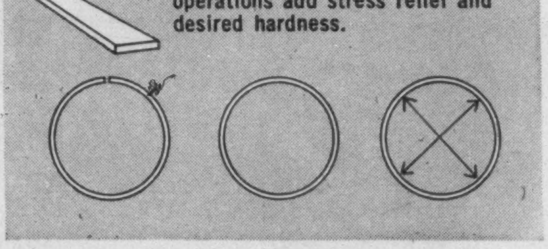
can be a hidden enemy of circular parts like jet-engine rings. To insure physical and metallurgical accuracy, specify Cleve-Weld welded rings.

Top Jet-Engine makers specify Cleve-Weld rings

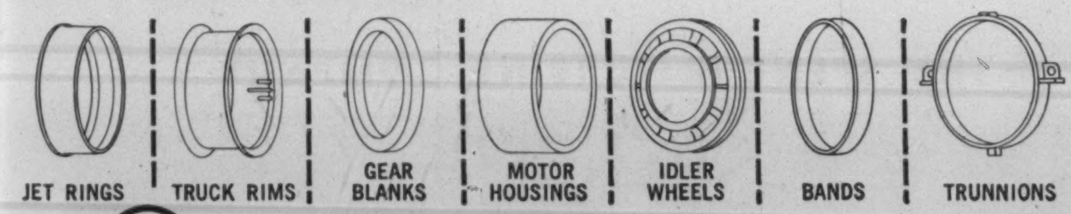
The *design, metallurgy* and *production* of welded circular parts have been Cleve-Weld specialties for 45 years. We've worked with materials from carbon to stainless and the latest aircraft alloy steels. Cleve-Weld has the specialized equipment and experience to do exacting jobs. These are the reasons why America's jet-engine makers procure Cleve-Weld rings. Pratt & Whitney J-57, Wright Aeronautical J-65, General Electric J-47 and other great jet engines testify to our ring accuracy.

Cleve-Weld is also a prime supplier of truck and tractor rims, rings, bands and gear blanks. *Make Cleve-Weld your primary source for all rolled and welded circular parts, too.* We'll show you why in dollars and cents. Write Circular Welded Products Sales Department below.

THIS IS THE BASIC CLEVE-WELD PROCESS. Rectangular bars or special contoured sections of steel are rolled into a circular form. Next, the part is welded and then expanded into a true circle. This tests the weld and insures accuracy. Later operations add stress relief and desired hardness.



EXAMPLES OF CLEVE-WELD PROCESS PRODUCTS



Another AMF Product
CLEVE-WELD PROCESS
RIMS • RINGS • WELDMENTS

CLEVELAND WELDING DIVISION
AMERICAN MACHINE & FOUNDRY COMPANY
Cleveland 7, Ohio

SEND THIS COUPON NOW

Cleveland Welding Division
American Machine & Foundry Company
West 117th Street and Berea Road
Cleveland 7, Ohio

Please send me:
☐ Truck Rim Catalog
☐ Tractor Rim Catalog
☐ Brochure on Cleve-Weld Process

Name________________________

Title________________________

Attach to your company letterhead and mail

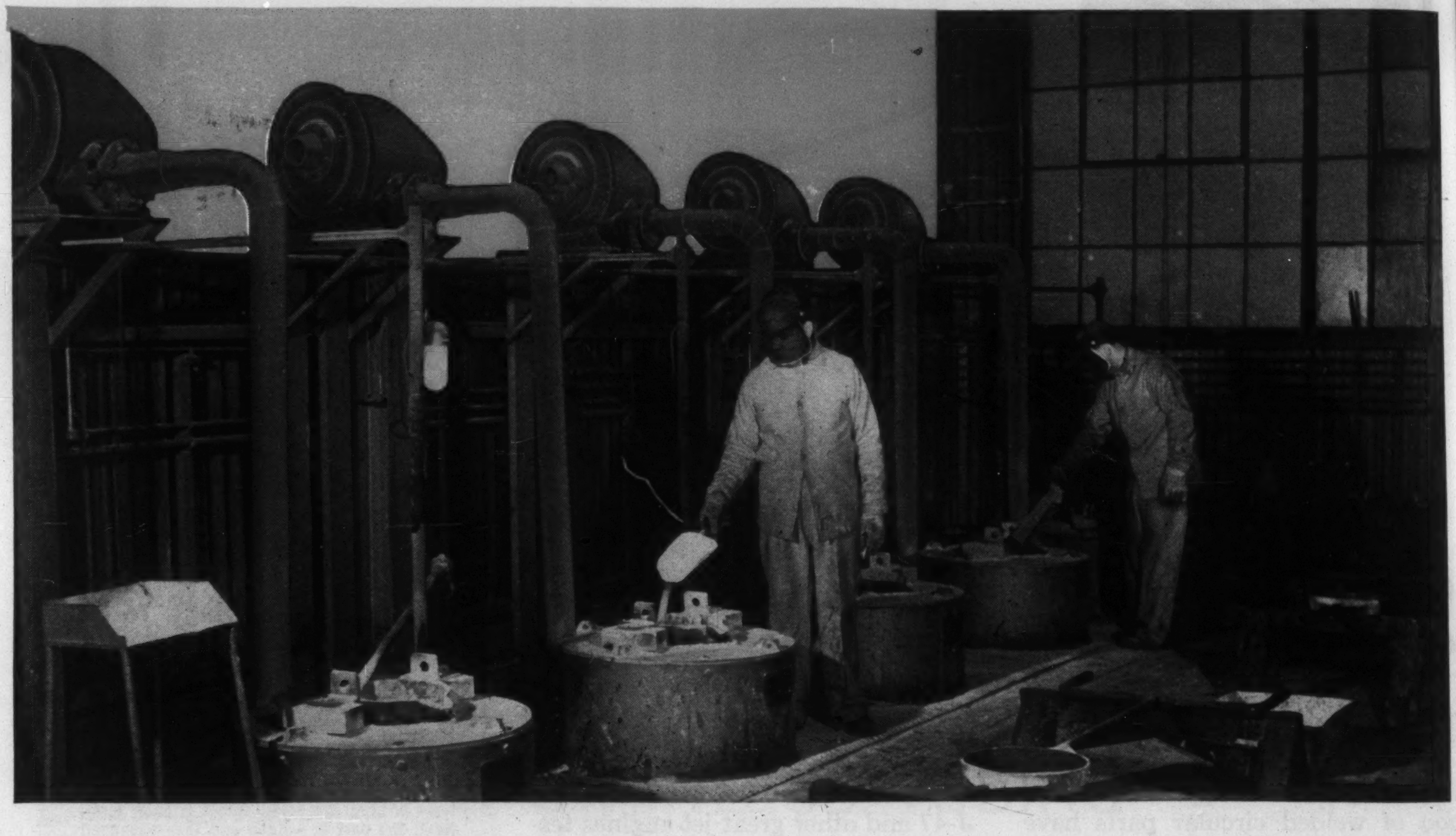
For more information, turn to Reader Service Card, Circle No. 399

Nonferrous Melting with . . .

SPENCER
HARTFORD

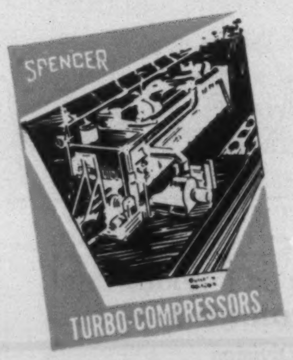
TURBO-COMPRESSORS

There are many methods of melting non-ferrous metals but the accepted standard for furnishing air to Oil and Gas fired furnaces is the Spencer Turbo-Compressor. A battery of Spencer 5 HP turbos in the foundry of a large Chemical plant is shown below.



Thirty-five years ago the Spencer Turbo was first specified by a furnace manufacturer. Today it is the first choice of all of the leading furnace and oven manufacturers.

The reasons they prefer Spencer are the absolute reliability—perfect performance and low maintenance over long years of almost continuous service. Spencer Turbos range in size from 35 to 20,000 cu. ft. per min., 4 oz. to 10 lbs. and 1/3 to 1,000 HP.



For complete description
of the standard and
special Turbos ask for
Bulletin No. 126-A.

THE SPENCER TURBINE COMPANY

SPENCER
HARTFORD

HARTFORD 6
CONNECTICUT

494-N

Manufacturers of Turbo-Compressors and Heavy Duty Vacuum Cleaners

For more information, turn to Reader Service Card, Circle No. 406

The Speed of Iron Powder Plus the Quality of Low Hydrogen is combined in the

New Iron-Powder Low-Hydrogen Electrodes

for high-speed all-position welding

Now, with P&H Iron Powder-Low Hydrogen Electrodes, you get a cost-cutting rod that permits high-speed, all-position welding, even on "problem" steels. You not only get the improved bead appearance and low spatter of iron-powder electrodes, but also the superior physical properties and quality of low-hydrogen rods.

P&H Iron Powder-Low Hydrogen Rods are recommended for welding of heavy sections exposed to severe shock and abuse. They give you welds of X-Ray quality with good impact properties at low temperatures. Moreover, you get smooth fillets without special effort.

Choose from a complete selection of P&H Iron Powder-Low Hydrogen Electrodes with tensile strengths from 70,000 to 85,000 psi.

HARNISCHFEGER
MILWAUKEE 46, WISCONSIN

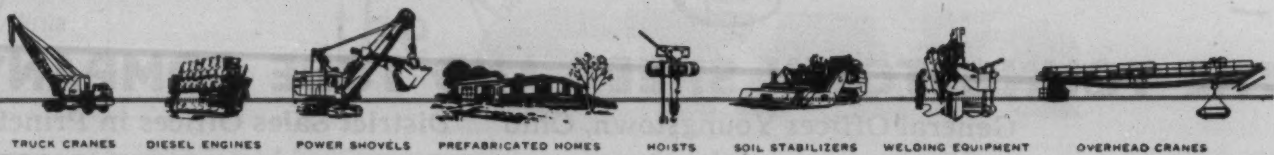
I'M SMOOTH-ARC SCOTTY... and if you're like me you never pass up a chance to save an extra nickel. P&H Iron Powder-Low Hydrogen Rods save more than that. Our FREE literature tells you how.

Send coupon for free information

P&H HARNISCHFEGER CORPORATION
Welding Division
4550 West National Avenue, Milwaukee 46, Wis.
Attention: W. R. Stephens, Sales Manager
Please send me more information on P&H Iron Powder-Low Hydrogen Electrodes.

Name...Title.........................
Company..
Address...
City...............................Zone..........State.....................
3083

the P&H Line



P&H welding equipment is manufactured and sold in Canada by REGENT EQUIPMENT MANUFACTURING COMPANY LTD., 455 King Street West • Toronto, Ontario, Canada

For more information, turn to Reader Service Card, Circle No. 367

Here's quality in a wide variety . . . and it starts with the basic material

. . . YOUNGSTOWN COLD FINISHED BARS

Lamson & Sessions bolts, nuts and cap screws have established a world-wide reputation as fasteners of quality and dependability. To gain such a reputation is not accidental. It is, rather, the result of careful planning, exact selection of materials and precision manufacturing. The basic material, as an example, is Youngstown Cold Finished Bars.

The uniformly high quality of Youngstown Cold Finished Bars makes possible uniform products. It is a uniformity that starts in the Bessemer or Open Hearth and is maintained throughout manufacture. Composition, structure and surface conditioning combined with "know how" in cold finishing, assure the highest quality, Specify Youngstown - - your best assurance of quality.

QUALITY YOUNGSTOWN SERVICE

Youngstown

COLD FINISHED BARS

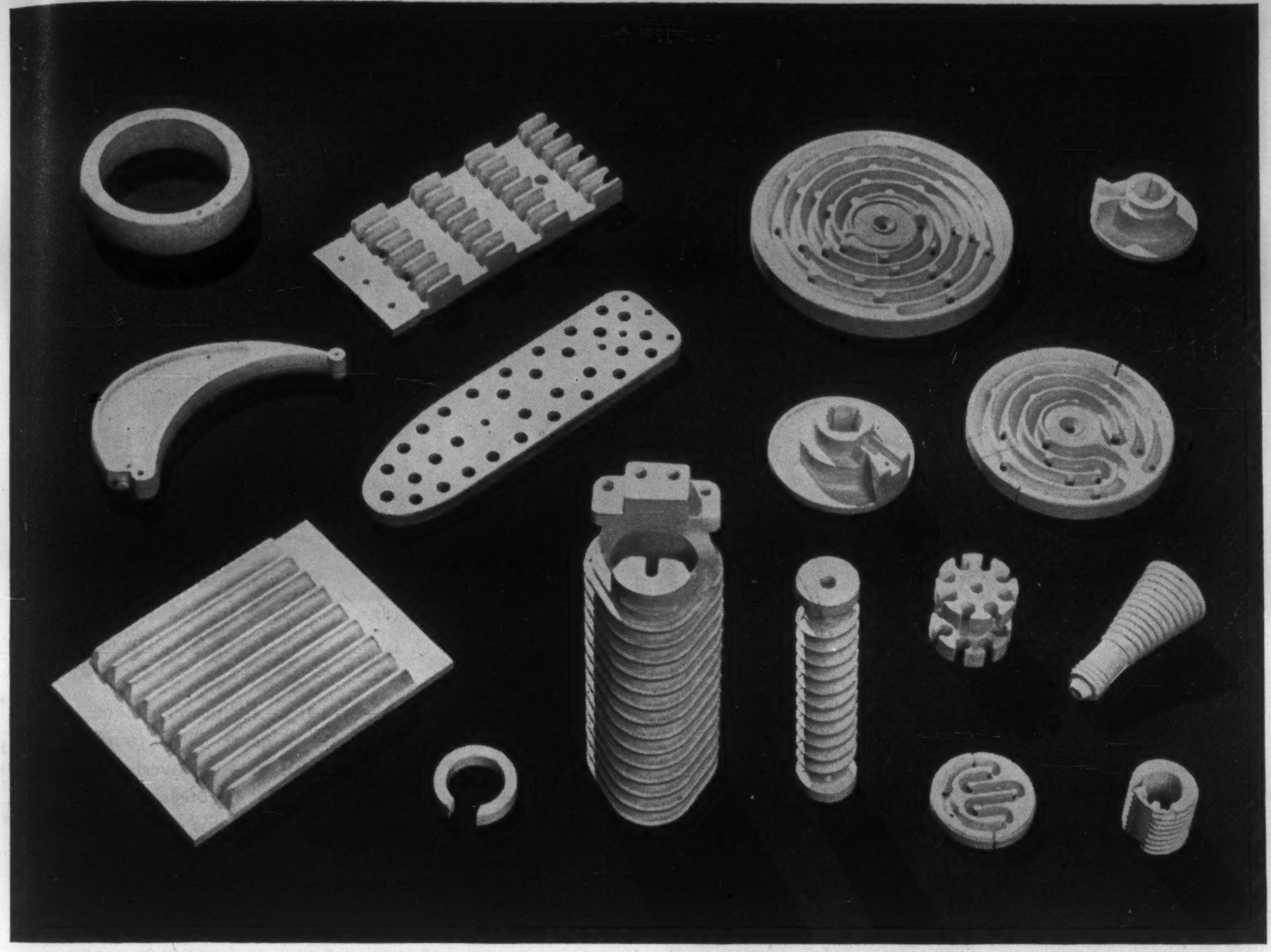
THE YOUNGSTOWN SHEET AND TUBE COMPANY

Manufacturers of Carbon, Alloy and Yoloy Steel

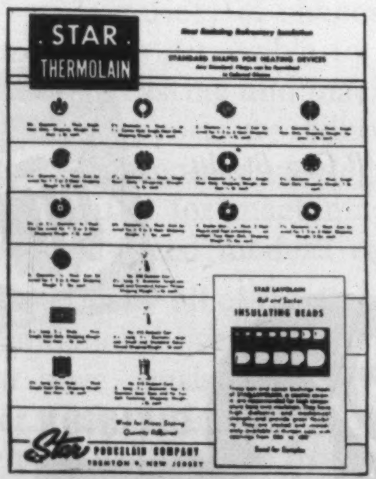
General Offices Youngstown, Ohio District Sales Offices in Principal Cities.

SHEETS - STRIP - PLATES - STANDARD PIPE - LINE PIPE - OIL COUNTRY TUBULAR GOODS - CONDUIT AND EMT - MECHANICAL TUBING - COLD FINISHED BARS - HOT ROLLED BARS - WIRE - HOT ROLLED RODS - COKE TIN PLATE - ELECTROLYTIC TIN PLATE - BLACK PLATE - RAILROAD TRACK SPIKES - MINE ROOF BOLTS

For more information, turn to Reader Service Card, Circle No. 387



when the heat's on...



. STAR .
THERMOLAIN

STANDARD SHAPES FOR HEATING DEVICES

INSULATING BEADS

Star PORCELAIN COMPANY
TRENTON 9, NEW JERSEY

WANT THE FACTS?

Standard refractory shapes are shown on our new data sheet together with sizes, weights and other pertinent engineering data. Write for a free copy today!

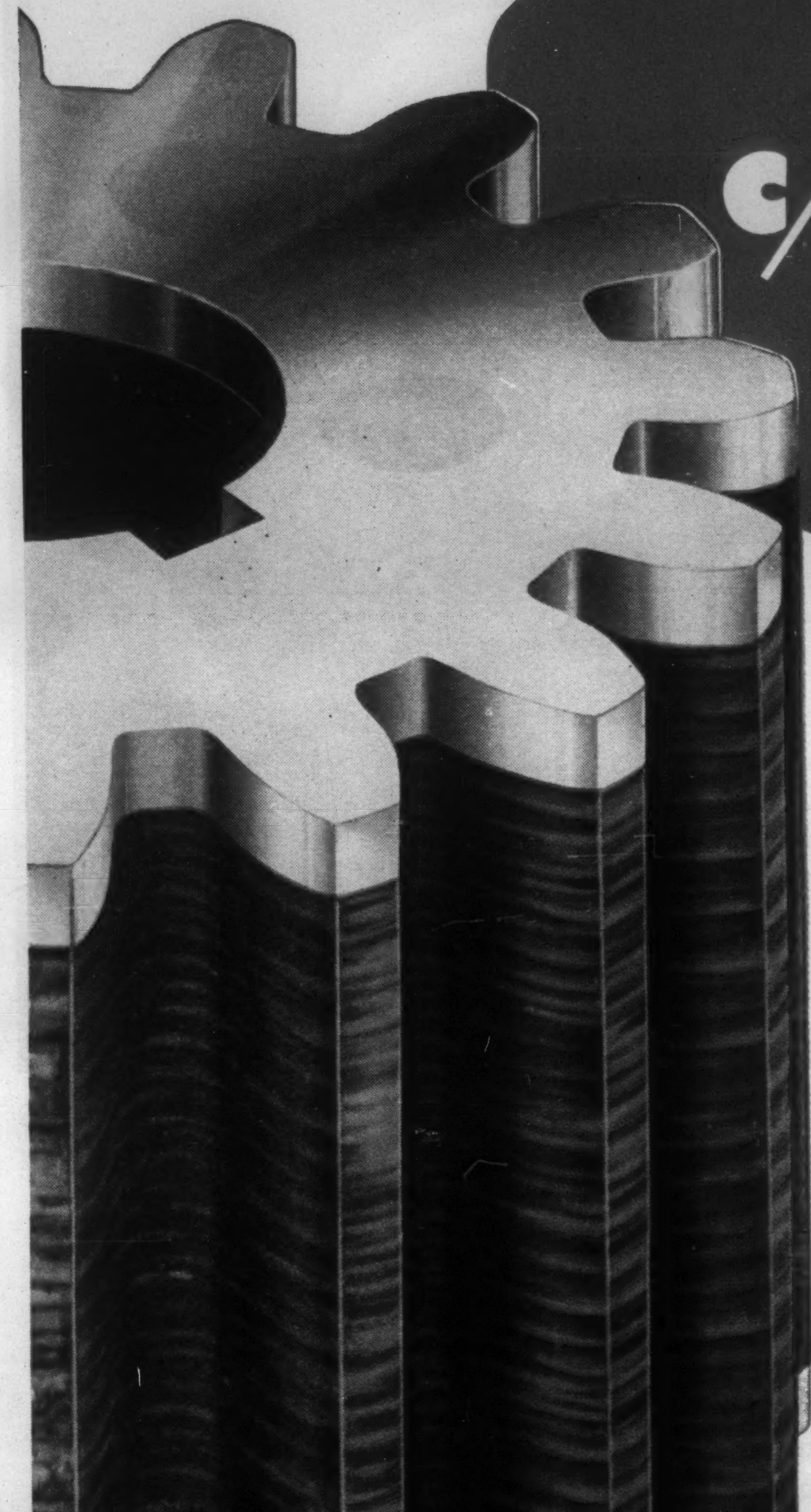
. . . you can really depend on Star THERMOLAIN® refractory porcelain for exceptional performance in *any* electrical heating device you manufacture . . . broilers, radiant heaters, ranges, water heaters, roasters, coffee-makers, air heaters, rheostats, immersion heaters . . . hundreds more!

Star THERMOLAIN offers good mechanical strength *plus* excellent thermal shock resistance . . . a combination that means long, trouble-free heating-element life and user satisfaction. Remember the name . . . Star THERMOLAIN . . .
it's synonymous with quality products.

The Star Porcelain Company, 39 Muirhead Avenu
Trenton 9, New Jersey

the STAR
porcelain company

• For more information, turn to Reader Service Card, Circle No. 445



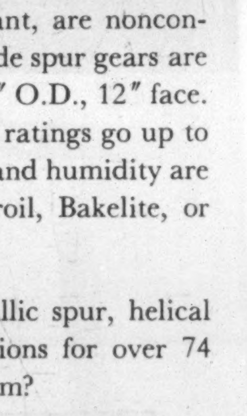
Do you know what C/R RAWHIDE GEARS can do for you?

HERE'S WHAT—They will transmit power quieter, with less vibration than other types of gears. These tough, resilient Rawhide gears will absorb momentary overloads up to 3 times their rated H.P. capacity . . . protecting expensive metal gears. Since C/R Rawhide pinions cause negligible wear, they actually prolong the life of mating metal gears.

MORE FACTS—They require no lubricant, are nonconductors, and are extremely durable. Rawhide spur gears are cut in sizes from 1″ O.D., ¾″ face up to 30″ O.D., 12″ face. D.P.'s range from 48″ to 1¼″; horsepower ratings go up to 50 H.P. or more. Where high temperature and humidity are factors, C/R gears cut from Nylon, Fabroil, Bakelite, or Micarta may be more suitable.

ASK C/R—We've been cutting non-metallic spur, helical and bevel gears for all types of applications for over 74 years. May we help solve your gear problem?

Please write for illustrated C/R Gear Booklet.



GEAR C/R DIVISION

CHICAGO RAWHIDE

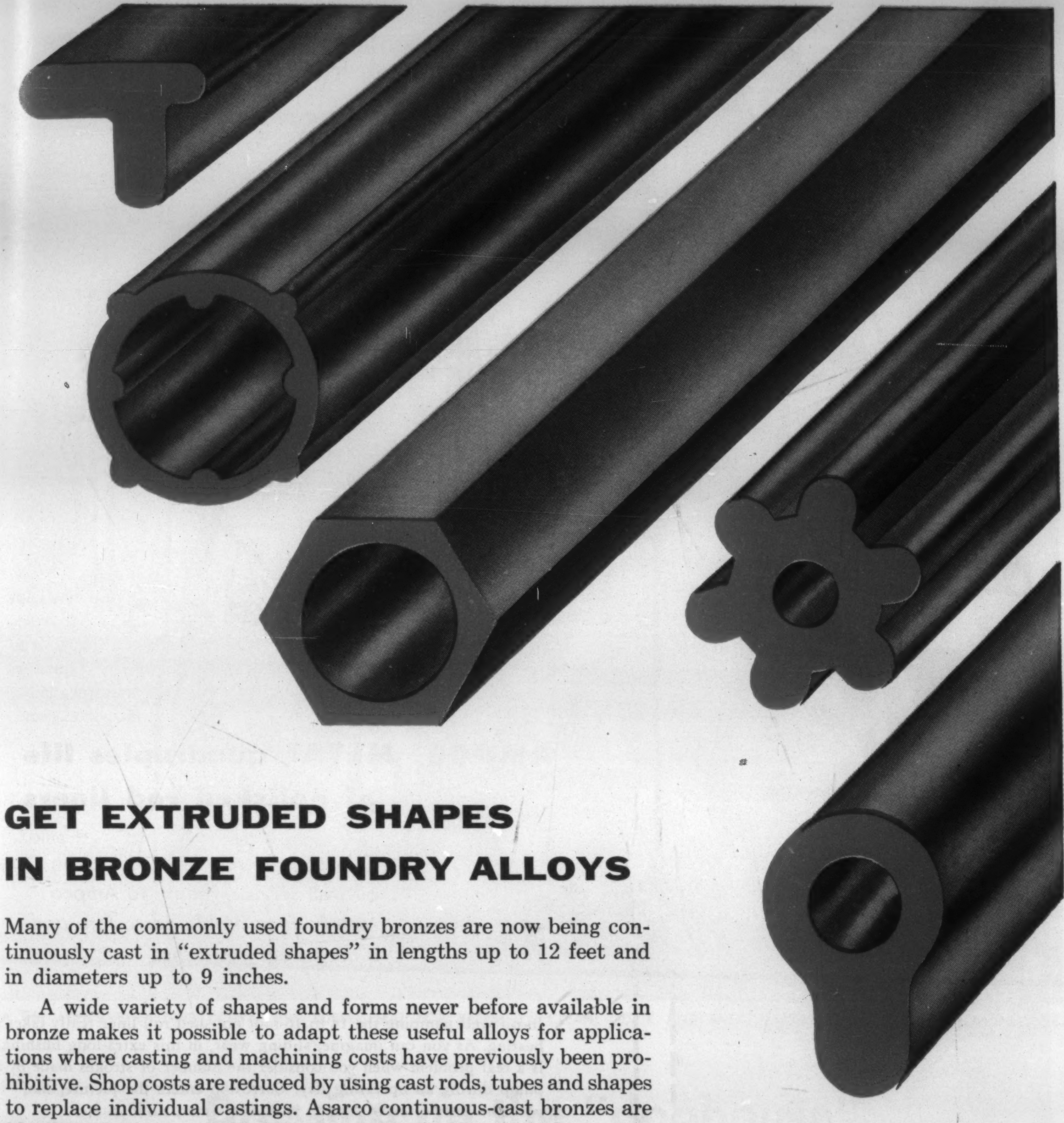
CHICAGO RAWHIDE MANUFACTURING COMPANY
1227 Elston Avenue • Chicago 22, Illinois

Offices in 55 principal cities. See your telephone book.

In Canada: Super Oil Seal Mfg. Co., Ltd., Hamilton, Ontario
Export Sales: Geon International Corp., Great Neck, New York

Other C/R Products
C/R Shaft & End Face Seals • Sirvene (synthetic rubber) molded pliable parts • Sirvis-Conpor mechanical leather cups, packings, boots

For more information, turn to Reader Service Card, Circle No. 552



GET EXTRUDED SHAPES IN BRONZE FOUNDRY ALLOYS

Many of the commonly used foundry bronzes are now being continuously cast in "extruded shapes" in lengths up to 12 feet and in diameters up to 9 inches.

A wide variety of shapes and forms never before available in bronze makes it possible to adapt these useful alloys for applications where casting and machining costs have previously been prohibitive. Shop costs are reduced by using cast rods, tubes and shapes to replace individual castings. Asarco continuous-cast bronzes are ideally suited for machining on automatic screw machines and other high-speed modern equipment.

Practically all of the standard tin-bronze alloys, including lead, zinc and nickel-bearing varieties, are being continuously cast to size. They have consistently better uniformity and machinability for faster work and longer tool life. Physical properties are improved as much as 100 percent over similar alloys cast by other methods.

Get in touch with your nearby Asarco distributor, or write to us directly for complete information on Continuous-cast Bronze.

Continuous-Cast Products Department

AMERICAN SMELTING AND REFINING COMPANY

Perth Amboy Plant, Barber, New Jersey • Whiting, Indiana
WEST COAST SALES AGENT: Kingwell Bros. Ltd., 457 Minna Street, San Francisco
IN CANADA: Federated Metals Canada, Ltd., Toronto and Montreal

ASARCO

For more information, turn to Reader Service Card, Circle No. 491

AMPCO* METAL quadruples life of polished rod liners

Critical part sets new records in tough oil-well service, thanks to Ampco Metal's remarkable corrosion- and sliding-wear resistance

In oil well pumping the 14 to 16-foot polished rod liner really takes a beating. As you can imagine, sliding wear, in this extra-long bushing, is a real problem when you consider the number of strokes made by a pump during an operating day. Corrosion enters the picture, too, with the liner often in contact with salt water, sulfides, etc.

With ordinary bronzes, Cities Service Oil Company found frequent replacement to be a constant headache. Then, in certain areas, it switched to liners made from Ampco Metal Pipe. Cities Service engineers report a substantial reduction in liner replacements.

Ampco Metal Liners last four times as long as plain bronze liners because they are made from a unique aluminum bronze alloy. It's a remarkable bearing material—has unusual resistance to mechanical wear. It withstands the corrosive effects of many acids and caustics. And when used as pipe it combats erosion from solids held in suspension.

Ampco pipe and tubing is available in all sizes, along with a complete line of flanges and fittings. Send coupon today for full information.

*Reg. U. S. Pat. Off.

D-45

AMPCO METAL, INC.
Dept. MA-6, Milwaukee 46, Wisconsin

I'm interested in knowing more about the wear- and corrosion-resistant properties of Ampco Metal. Please send me complete information.

Name..Title........................

Company..

Company Address..

City.......................................(......) State........................

AMPCO®

AMPCO METAL, INC.

Sole Producer of Genuine Ampco Metal

Main Office and Plant
Milwaukee 46, Wisconsin
West Coast Plant
Burbank, California

For more information, turn to Reader Service Card, Circle No. 541

See what adhesives are doing today!

A 3M ADHESIVE FASTENS DOWN THIS RUBBER MAT FOR KEEPS. IT'S CLEAN, QUICK AND EASY, MAKES NO MESS IN THE CAB INTERIOR.

Dressing up the "doghouse"

How would you fasten the trim on this truck engine cover? The fastener must fight heat, stress and vibration. And it has to be able to hold this rubber mat tight year after year, for hundreds of thousands of punishing miles.

Yet a 3M adhesive does the job. This worker quickly brushes EC-882 on the painted "doghouse", presses the rubber mat in place. High-strength, fast-drying EC-882 grips immediately and for keeps. In addition, EC-882 bonds rubber weather strip to the cab's enameled doors and door frames.

Another 3M adhesive, EC-871, fastens fibrous glass insulation to the cab roof and vinyl-coated jute to back and side panels. After 15 years of using 3M adhesives, this manufacturer can't recall one case of adhesive failure.

SEE WHAT ADHESIVES CAN DO FOR YOU!

Hundreds of 3M adhesives serve many varied industries. Consult 3M research. Call your 3M Field Engineer. For a free booklet and information write: 3M, Dept. 66, 417 Piquette Ave., Detroit 2, Mich.

PRODUCT OF 3M RESEARCH

3M® ADHESIVES

ADHESIVES AND COATINGS DIVISION, **MINNESOTA MINING AND MANUFACTURING COMPANY**

417 PIQUETTE AVE., DETROIT 2, MICH. • GENERAL SALES OFFICES: ST. PAUL 6, MINN. • EXPORT: 99 PARK AVE., N. Y. 16, N. Y. • CANADA: P. O. BOX 757, LONDON, ONT.

MAKERS OF "SCOTCH" BRAND PRESSURE-SENSITIVE ADHESIVE TAPES • "SCOTCH" BRAND SOUND-RECORDING TAPE • "SCOTCHLITE" BRAND REFLECTIVE SHEETINGS • "3M" ABRASIVE PAPER AND CLOTH • "3M" ADHESIVES AND COATINGS • "3M" ROOFING GRANULES • "3M" CHEMICALS

REG. U. S. PAT. OFF.

For more information, turn to Reader Service Card, Circle No. 432

MUELLER BRASS CO. improves LENSOMETER lower cost

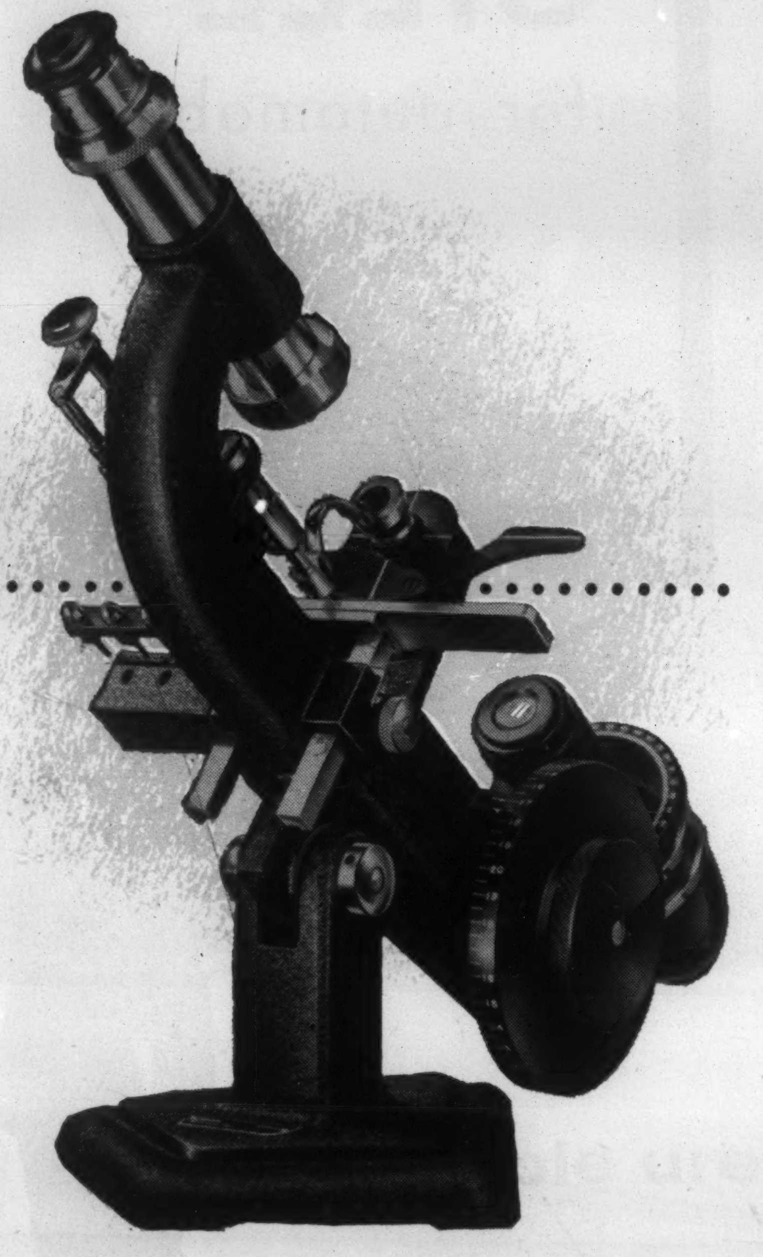
FORGED PART APPROXIMATELY ½ SIZE

Precision and extreme accuracy are vitally important functions of the Lensometer, manufactured by the Instrument Division of the American Optical Company, Buffalo, N. Y. The Lensometer is used to determine the focal strength and axis of an optical lens and, consequently, must be extremely precise in operation to provide accuracy and uniformity in lens prescriptions.

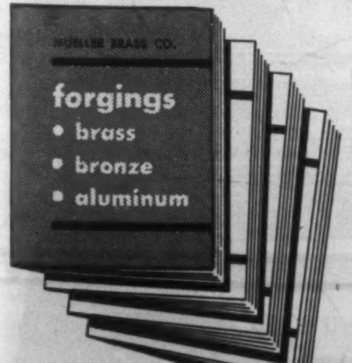
Forgings made by the Mueller Brass Co. play an important role in the construction of the Lensometer and contribute to its outstanding performance. Formerly, the body of the Lensometer was produced from *three* sand castings, but these now have been replaced by just *two* forgings. Naturally, this simplifies assembly, and the big forged bronze main support arm, shown above, along with the lens support bracket insures the constantly accurate alignment of the instrument. During the first year when forgings were used instead of castings, American Optical not only recovered the initial tooling costs but also realized considerable savings on each Lensometer produced. This is another good example of the way Mueller Brass Co. forgings can benefit a product two ways . . . better performance and lower costs. Chances are, your product can likewise be improved at a savings to you if you specify brass, bronze or aluminum forgings made by the Mueller Brass Co.

FORGING

at substantially



• WRITE TODAY FOR THE ENGINEERING MANUAL YOU NEED



Mueller Brass Co. Forgings Engineering Manual H-58565 ☐

Tuf-Stuf Aluminum Bronze Alloys Engineering Manual H-58563 ☐

600 Series Bearing Alloys Engineering Manual FM-3000 ☐

Copper Base Alloys in Rod Form Engineering Manual FM-3010 ☐

METALS AND ALLOYS REVIEW

by FRANK M. LEVY

Vice-President and Director of Research

One of our most interesting series of alloys is the group which we market under the tradename "Tuf-Stuf" . . . a group of aluminum bronze alloys with range and flexibility to meet the most demanding needs. They are high copper base alloys containing from 9% to 13% aluminum and varying amounts of iron, nickel and manganese. Being free of zinc, they are not subject to dezincification. Tuf-Stuf alloys have a low coefficient of friction, good wearing qualities, high tensile strength, high hardness and the ability to withstand heavy pounding. Some of the alloys can be hardened by heat treatment. In the harder grades, these alloys are used for heavy duty service where high compressive loads are encountered and where lubrication may be scant. Present day increases in operating speed of modern machine equipment and the economy of little or no machine "down" time has made Tuf-Stuf popular in the machine tool industry. It is used in a multitude of applications where resistance to wear is important, such as: Drill Jigs, Feed Nuts, Rollers, Cams, Collets, Gibs, Gears, Boring Bar Guides, Lead Screw Nuts and Clutch Shifter Forks. Also, because of their ability to withstand higher stresses and resist season-cracking, these alloys are ideally suited for threaded nuts and bolts and pole-line hardware.

The unusual physical properties of the Tuf-Stuf series have made it particularly useful in the chemical and allied industries. These alloys combine the strength and ductility of medium steel with high resistance to corrosion by many chemicals. Tuf-Stuf alloys will not only resist oxidation at elevated temperatures, but will also retain a greater portion of their strength and hardness at these temperatures than will the copper zinc alloys. These properties make them ideal in the aircraft industry for valve seat inserts, spark plug bushings, valve guides and propeller hub cones.

Tuf-Stuf alloys are supplied as forgings, rod or screw machine products. As forgings the grain structure can be controlled to produce parts that are strongest at points of greatest stress and strain. Relatively intricate shapes can be forged to closer tolerances than sand castings. Where appearance is a factor, a forging may easily prove more economical since a minimum amount of machining, buffing or polishing is required before finishing.

If you'd like more information about this series of alloys, drop me a line or better yet, send me your sample part or blueprint and an explanation of its use and we'll be glad to submit our recommendations.

MUELLER BRASS CO.

PORT HURON 16, MICHIGAN

178

For more information, turn to Reader Service Card, Circle No. 499

in a new car . . .
in a used car . . .

stainless steel sells and re-sells

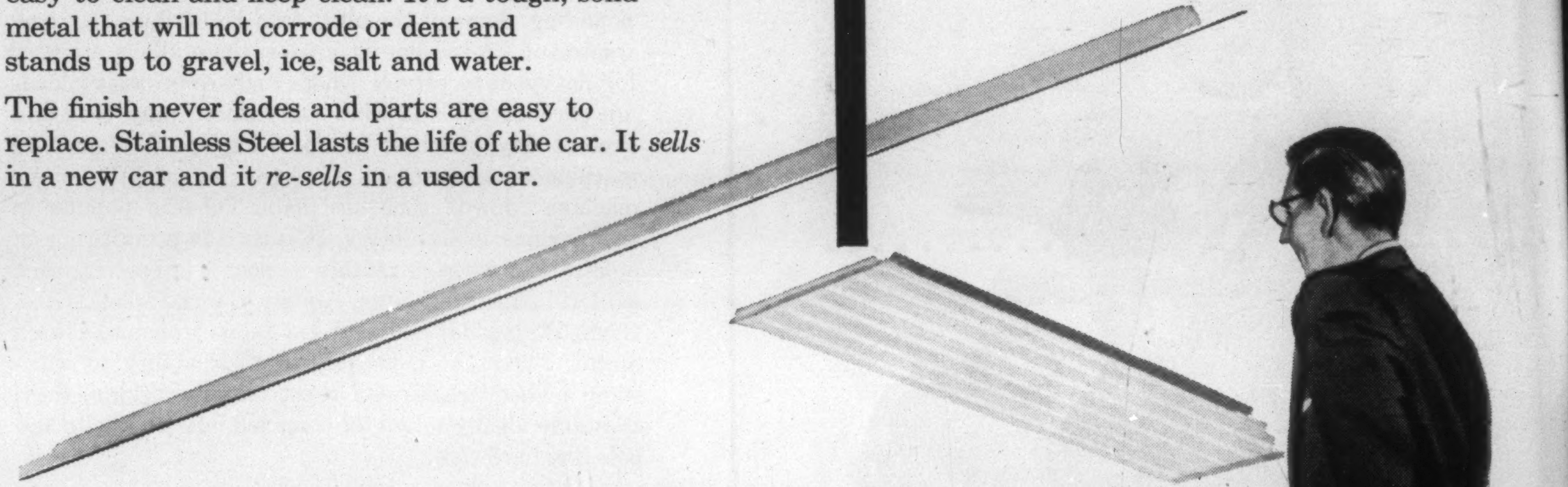
The Stainless Steel trim, molding and vital parts that add style and beauty to a car, inside and out, are features that help make the sale.

Stainless Steel has wide customer acceptance. It's easy to clean and keep clean. It's a tough, solid metal that will not corrode or dent and stands up to gravel, ice, salt and water.

The finish never fades and parts are easy to replace. Stainless Steel lasts the life of the car. It *sells* in a new car and it *re-sells* in a used car.

McLOUTH STAINLESS STEEL

for automobiles



McLOUTH STEEL CORPORATION
Detroit, Michigan

Manufacturers of Stainless and Carbon Steels

For more information, turn to Reader Service Card, Circle No. 557

oh, the products and profits you'll make with flexible urethane foams

A brand new material for industry.

So soft, this glistening foam makes the most amazing cushioning you have ever seen . . . but it's so tough it can be metal-stapled directly to wood or springs!

So wear resistant, it looks and feels brand new even after 6 million flexes . . . but so light a 2-inch slab a yard square can weigh as little as 3 pounds.

And so controllable! You can specify any density from 2 lbs. to 6 lbs. per cubic foot and get just the degree of compressibility, resiliency or firmness you want.

Until you've seen, squeezed, sat-on, and tried to tear urethane foam—you have no idea all the new product ideas that will pop into your mind once you handle it. Here is a wear-resistant, "cushion-y" foam that resists chemicals and dry-cleaning solvents, that insulates against heat or cold . . . that you can slice, cut, stamp, heat-form, cement, sew, and staple into new or better products. Examine these feather-light, tough, flexible foams—you'll agree they are a manufacturer's dream of a new material come true.

If you'd like to learn more about urethane foams, just write on your company letterhead, briefly describe the application you have in mind. You'll receive requested information by return mail.

MOBAY CHEMICAL COMPANY
Dept. MM-1
St. Louis 4, Missouri

Flexible urethane foams are already in use or under development for these applications:

- New-car crash pads
- Automobile door and roof lining
- Rug underlay
- Jacket fabric interlayer
- Chemically-resistant sponges
- Upholstering
- Toys
- Theatre seating
- Aircraft cabin liners

An associate company of Monsanto

For more information, turn to Reader Service Card, Circle No. 433

MOBAY

Typical Physical Properties of Forticel

Flow temperature:		
(°C.) (A.S.T.M.) . .	D569-48	167—178
Specific gravity: . . .	D176-42T	1.18—1.21
Tensile properties:		
Yield (p.s.i.)	D638-52T	3380—5020
Break (p.s.i.) . . .	D638-52T	3470—5240
Elongation (%) . . .	D638-52T	56—66
Flexural properties:		
Flexural strength (p.s.i. at break) . . .	D790-49T	6400—8500
Flexural modulus (10^6 p.s.i.)	D790-49T	0.23—0.30
Rockwell Hardness:		
(R scale)	D785-51	62—94
Izod Impact:		
(ft. lb./in. notch) . .	D256-43T	2.7—11.0
Heat distortion:		
(°C.)	D648-45T	59—70
Water absorption:		
% Sol. lost	D570-42	0.00—0.08
% Moisture gain . .	D570-42	1.5—1.8
% Water absorption .	D570-42	1.6—1.8

Celanese Corporation of America, Plastics Division,
Dept. 102-F, 290 Ferry Street, Newark 5, N. J.

Send me New Product Bulletin NP-16 on Forticel Plastic.

NAME______________________________

TITLE______________________________

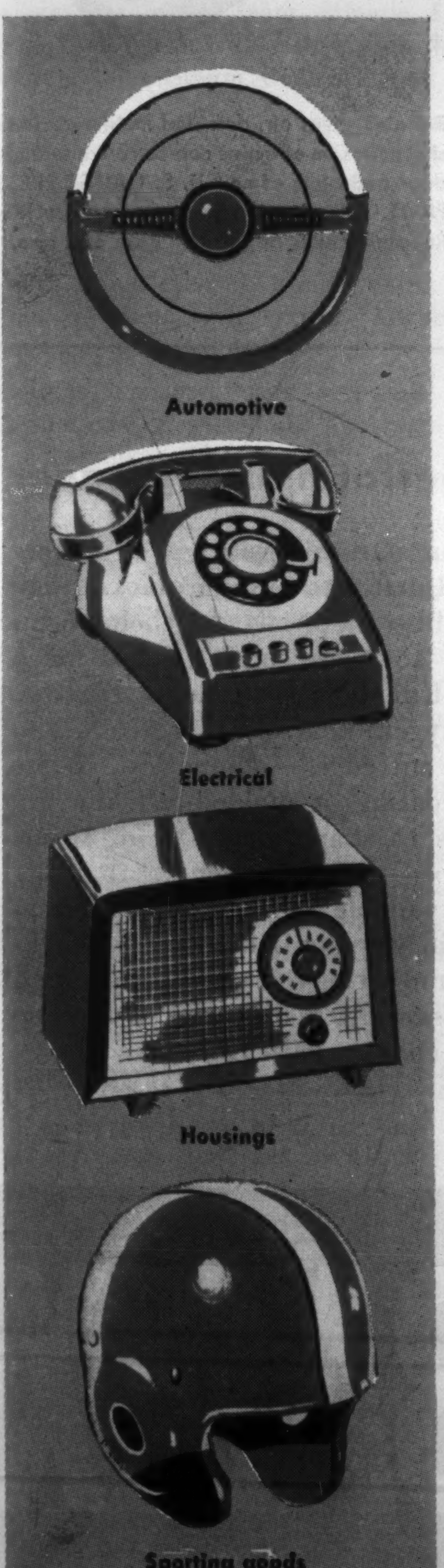
COMPANY____________________________

ADDRESS____________________________

CITY______________ZONE_____STATE__________

For more information, turn to Reader Service Card, Circle No. 366.

You could call FORTICEL *the "write" plastic!*



New Celanese Molding Thermoplastic offers unique balance of properties for wide range of product manufacture

Today, America's most popular fountain pens and mechanical pencils are being made of Forticel. And this has happened within months of the introduction of this brilliant, new Celanese Plastic!

For the same reasons that Forticel is the *right* plastic for everything from automobile arm rests to portable radio cabinets. Forticel has overnight become the accepted plastic in the writing instrument field.

Consider these Forticel advantages as the penmakers do:

- **Durable Surface Lustre**
- **Brilliant Molded Finish**
- **Wide Color Range**
- **Dimensional Stability**
- **Form Retention**
- **Superior Toughness**
- **Good Weatherability**
- **Superior Moldability**
- **Machinability Without Cracking or Crazing**
- **Freedom From Objectionable Odor**

Forticel combines in a single material perhaps the best balance of properties of any thermoplastic. What the penmakers have discovered it can do for their precision products, is indicative of what it can contribute to product improvement in a variety of fields: automotive, electrical, personal items, toys and sporting goods.

If you haven't already evaluated the new Forticel, send for Product Bulletin NP-16. Use coupon. Celanese Corporation of America, Plastics Division.

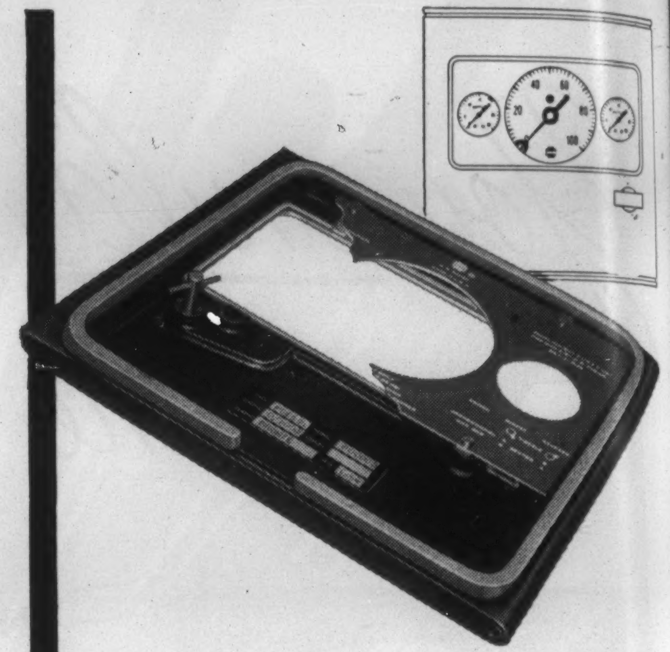
Celanese
plastics

Celanese® Forticel®

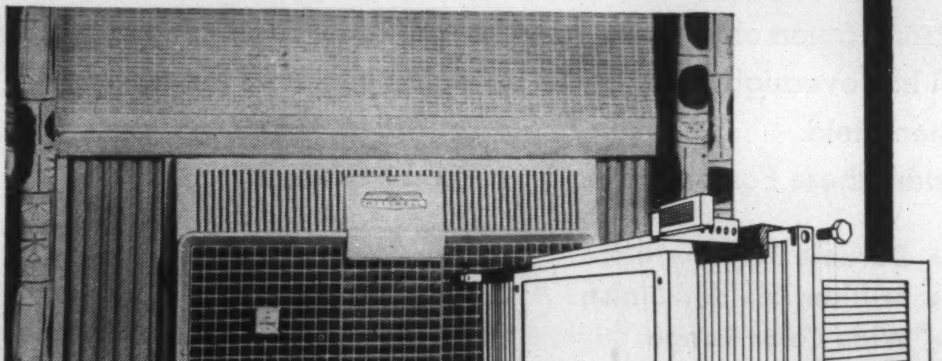
doing unusual jobs unusually well

for 20 years

Layers of Rubatex assure tight effective seal between metal pylon and metal wing surface of CHANCE VOUGHT'S F7U-3 CUTLASS. Also valuable for streamlining purposes and cushions the two metals when pylon is attached to wing of jet fighter.



Rubatex gives air, dust and moisture a technical shut out as an effective non-corrosive seal around door and glass of new U. S. GAUGE PRESSURE PILOT. Dribak adhesive on smooth surface of Rubatex makes application easy and sure.



Non-porous Rubatex gasketing is the perfect sealing agent for Expando-Mount installer (accordion pleated-like door which slides out to fit window openings) on MITCHELL ROOM AIR CONDITIONERS. Insures complete, durable, air-tight, water-tight, dust-tight installation for life of air conditioner.

better performance cheaper

Nitrogen plus natural resiliency of rubber team up in Rubatex to recover quicker than other soft rubber materials after being compressed and to keep coming back for a longer time. Unique closed cellular structure shuts out oxygen, heat, cold, moisture and dirt even at cut edges—eliminates expense for special coating or molded-on skin. No restriction as to shape or size. Can be die cut or stripped. Easily cemented to other materials. Available in soft, medium and firm grades in varying densities and thickness. Write and let us tell you how you can get better gasketing, sealing and cushioning performance cheaper with Rubatex.

PIONEER MANUFACTURER OF CLOSED CELLULAR RUBBER

also manufacturers of:

Rubatex Closed Cellular Vinyl
Rubatex Insulation Hardboard
Rubatex-Crepe
Rubatex Softee-Crepe
Rubatex Vinyl Foam
Rubatex Plastic Seine Floats

G.A.I. RUBATEX

GREAT AMERICAN INDUSTRIES, INC.
RUBATEX DIVISION, Bedford, Virginia

For more information, turn to Reader Service Card, Circle No. 469

DOW CORNING CORPORATION

Silicone News

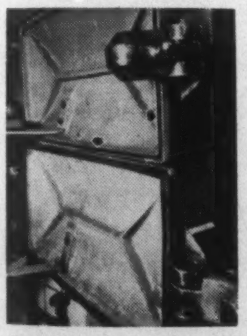
FOR DESIGN ENGINEERS No. 27

3 Year Test Proves Superiority Of Silastic Gaskets On Steam Cookers

Despite prolonged exposure to steam and pressure, Silastic*, Dow Corning's silicone rubber, keeps its shape, remains resilient, maintains an efficient seal. That's why the Cleveland Range Co. uses gaskets made from Silastic for sealing the doors of its well-known line of Steam-Chef Steam Cookers.

The change from organic rubber to Silastic was made after a three year field test program which proved the superiority of silicone rubber gaskets. Molded by the Ohio Rubber Co., these test gaskets were installed on Cleveland Range units in commercial and institutional kitchens throughout the midwest.

Restaurant managers were surprised to see at the end of six months, the average life of organic rubber gaskets, that the Silastic gaskets still looked as good and sealed as efficiently as when new. Time and rugged service apparently had little or no effect on the silicone rubber gaskets. Particularly impressive was the fact that Silastic did not absorb food oils or impart off-flavor taste to foods during cooking.

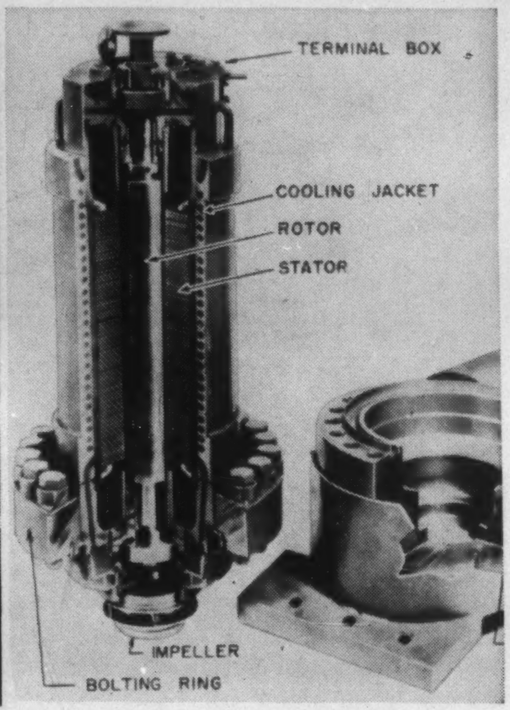


This photograph of a Steam-Chef Cooker in the Mill Restaurant, Cleveland, Ohio, shows the type of evidence compiled during this test. The

(cont'd. pg. 2)

---

* T. M. REG. U. S. PAT. OFF.



CANNED MOTOR-PUMP HANDLES RADIOACTIVE LIQUID COOLANTS

Utilizing the thermal stability of electrical insulation made with Dow Corning silicones, Westinghouse designers have developed a canned motor-pump that answers the Atomic Energy Commission's need for a way to circulate radio-active liquid coolants at temperatures up to 650 F in hermetically sealed hydraulic systems.

Used in the primary coolant system of nuclear reactors, both the pump impeller and its electric drive motor are encased in a single pressure-tight vessel. The hot, radioactive fluid circulates around the bearings, rotor and stator of the silicone insulated drive motor.

Stainless steel jacketing protects the ends and outside diameter of the stator windings. A thin, leak-tight, nickel-alloy cylinder or "can" lines the inner bore of the stator. The outer surface of the rotor is similarly canned.

Silicone-insulated canned motor-pumps of this design are now available in capacities

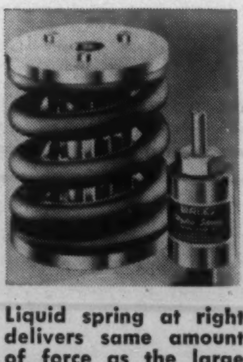
(cont'd. pg. 2)

Liquid Springs Use Silicone Fluid For Greater Efficiency

With compressibility of 9 to 10% at 20,000 psi compared to 6 or 6½% for mineral base oils, silicone fluids are specified by designers at Wales Strippit Corporation as the compressible media for their entire line of liquid filled "Hydra Springs."

Thermal stability and remarkably flat viscosity temperature slopes were also important considerations which led to the use of Dow Corning silicone fluids in these precision hydraulic devices. Most Hydra Springs employ Dow Corning 200 Fluid. A few, requiring special springing characteristics, utilize other Dow Corning silicone fluids.

Providing forces 3 to 6 times greater than coil springs of equal size, Hydra Springs have proved highly efficient and successful in metal working, dies, perforating equipment, testing equipment, ordnance devices, specialized machinery. *No. 268*



Liquid spring at right delivers same amount of force as the large cumbersome metal coil spring.

CLASS H MOTOR STILL ON TEST AFTER 56,715 HOURS AT 240 C

At 10 A.M., June 6, 1946, a Class H insulated 5 hp motor was generator loaded to operate at its test temperature of 240 C in Dow Corning's motor test labs. Every 500 hours since it has been shut down and exposed to 100% relative humidity for 24 hours. As of 11 A.M. May 1, 1956, this motor was still on test after 56,715 hours at an average copper temperature of 240 C! That's equivalent to 344 years operation at the Class H temperature of 180 C.

FOR DATA RELATING TO THESE ARTICLES, CIRCLE REFERENCE NUMBER IN COUPON ON NEXT PAGE

MORE ☛

DOW CORNING
CORPORATION

Silicone News

DOW CORNING PUBLICATIONS ON NEW DEVELOPMENTS AND TECHNICAL DATA . . . .

Dow Corning Z-4141, an easily applied silicone treatment for glass surfaces, imparts a high degree of scratch resistance and reduces breakage. Effective at low concentrations on bottles and containers, light bulbs and tubing, camera lenses, and artware. *No. 273*

●

"Potting Gives Maximum Reliability", an article from ELECTRONIC EQUIPMENT, describes the method of encapsulating a new series of electronic devices developed by the Naval Ordnance laboratory. Using silicones helps to provide the utmost protection against mechanical and thermal shock, vibration, and humidity. *No. 274*

●

Now available—1956 Reference Guide to Dow Corning Silicone Products. A concise, comprehensive, 12-page reference that is convenient-to-use. It's packed with data, properties, and information on how you can use silicones in designing new equipment, improving performance and reliability of original equipment, or reducing production and maintenance costs. *No. 275*

●

Silicone-Glass Laminates for electrical and mechanical applications are described in new brochure which illustrates parts used in typical industrial applications. Also lists engineering information on properties of silicone-glass laminates and lists fabricators of such laminates. *No. 276*

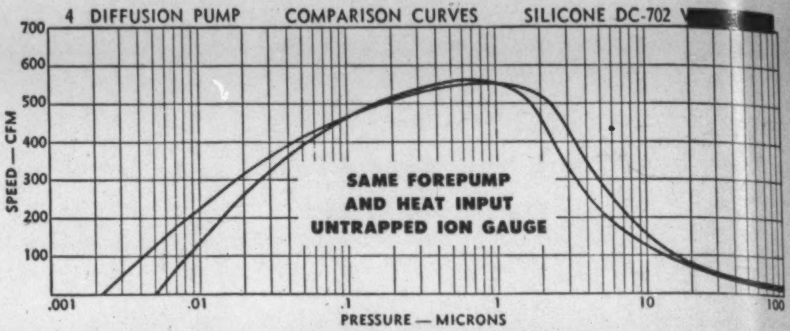
●

Dow Corning 510 Fluids are unsurpassed as damping media for instruments and other devices required to give uniform performance from —70 to over 400 F. Excellent dielectric properties plus relatively constant viscosities make these silicone fluids particularly adaptable to electrical and electronic equipment. *No. 277*

●

Documentary film "What's a Silicone?" available free of charge for showings to technical audiences in every industry. In full color and sound, this dramatic 16mm film allows you to see Dow Corning silicones in action improving the performance of products ranging from nursing bottle nipples to diesel locomotives. For more information about this educational film and how to arrange a showing for interested persons in your plant, circle ---------------- *No. 278*

Speed And Range Of Vacuum Pump Increased With Silicone Fluid



A series of tests conducted by the F. J. Stokes Machine Company, Philadelphia, world's largest producer of high vacuum equipment, prove that Dow Corning 702 Diffusion Pump Fluid helps to attain higher vacuum in less time than possible with organic fluids.

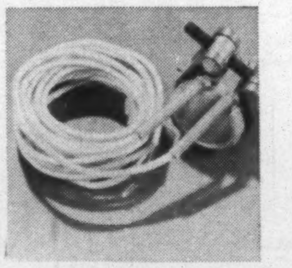
As indicated by the curve, the silicone fluid provides faster evacuation in the 1 to 10 micron range and at the same time assures lower ultimate pressures in the range between .01 and .001 microns.

The tests were performed in connection with development of Stokes' new line of Ring-Jet Diffusion Pump Series 160, and Ring-Jet Booster Pumps Series 150. Remarkably effective for rapid-cycle work, these pumps are available in 5 sizes from 4 to 16 inches.

The test results, since confirmed by experience in other Ring-Jet Pump models, have led Stokes to advise its representatives "since the organic fluid is almost the same in price as the silicone, the silicone fluid (Dow Corning 702) would be preferable, especially considering that it will not oxidize when subjected to the atmosphere at high temperatures." *No. 271*

Silastic Impregnated Sleeving Insulates Lead Wire in Strip Heater

Braided glass sleeving impregnated with Silastic, Dow Corning's silicone rubber, retains excellent flexibility and insulating effectiveness at temperatures that cause rapid failure of organic electrical insulating materials. The advantages of such sleeving are demonstrated in the small strip heaters manufactured by Watlow Electric Co., of St. Louis.



Not much larger than elbow spaghetti, these efficient 175 watt heating units are used by aircraft builders and other metal working companies to heat aluminum during dimpling or countersinking to provide flush mounting of rivets. Most aluminum alloys cannot be formed cold without setting up stresses.

Slipped over the dimpling die-tips, the heaters produce temperatures of 500 F and higher. The lead wires flex continually with movements of the die. To protect the lead wire with a high dielectric strength material that retains good flexibility at high temperatures, Watlow uses Turbo 117, a Silastic impregnated sleeving fabricated by The William Brand Co. Watlow reports silicone insulated sleeving has substantially reduced lead wire failures. *No. 272*

MOTOR-PUMP *(continued)*

from 5 to 17,000 gpm. They can handle high temperature liquids at system pressures up to 2500 psi.

According to Westinghouse, these pumps are also used in steam systems where controlled or forced circulation is required, and in certain process applications of the chemical and petroleum industries. Special canned motor-pumps are even available for pumping molten metal at temperatures as high as 1000 F. *No. 269*

COOKER GASKET *(continued)*

organic rubber gasket on lower door, hardened and flattened by heat and pressure, has completely lost its sealing efficiency. The narrow Silastic gasket on the top door is as effective as new after the same length of service. *No. 270*

Dow Corning Corporation, Dept. 7006, Midland, Michigan

Please send me: 268 269 270 271 272
273 274 275 276 277 278

NAME ____________________

TITLE ____________________

COMPANY ____________________

STREET ____________________

CITY ____________ ZONE ____ STATE ____________

SILICONE NEWS is published for product design and development engineers by

first in silicones

DOW CORNING CORPORATION
MIDLAND MICHIGAN

DOW CORNING
SILICONES

ATLANTA BOSTON CHICAGO CLEVELAND DALLAS DETROIT LOS ANGELES NEW YORK WASHINGTON, D.C. (SILVER SPRING, MD.)
CANADA: DOW CORNING SILICONES LTD., TORONTO GREAT BRITAIN: MIDLAND SILICONES LTD., LONDON FRANCE: ST. GOBAIN, PARIS

Brass—Gleaming brass coated strip from Thomas offers manufacturers electrolytically pre-coated steel with a finish that can be oxidized readily to a variety of shades. Subsequent lacquering gives an attractive and permanent final product finish. Here is steel's strength and economy with the advantages of brass. It protects parts-in-process against corrosion and lends itself readily to production of small stampings, drawn parts, tubing and roll-formed sections. Available in natural, planished and buffed finishes in a variety of widths, tempers and gages.

Pattern Design Strip—"Thomas Strip is the only company that can supply our requirements for Pattern Design plated strip," says an official of Milwaukee's M. A. Gerett Corp., world's largest manufacturer of fine coin banks like those shown above in assembly. Thomas' lacquered copper, brass and nickel coated strip cut M. A. Gerett's rejection rate 7 percent. Piece buffing at Gerett was eliminated through adoption of Thomas' Pattern Design Strip. Die life increased, too, because the strip's coating acts as a lubricant during the forming operation. yet doesn't crack.

COLD ROLLED
STRIP STEEL

P

You Can Bank On Saving Money With Thomas Strip's Pre-coated Steel

Manufacturers using Thomas Strip—pre-coated with zinc, copper, brass, nickel, tin or lacquer—are piling up big dollar savings.

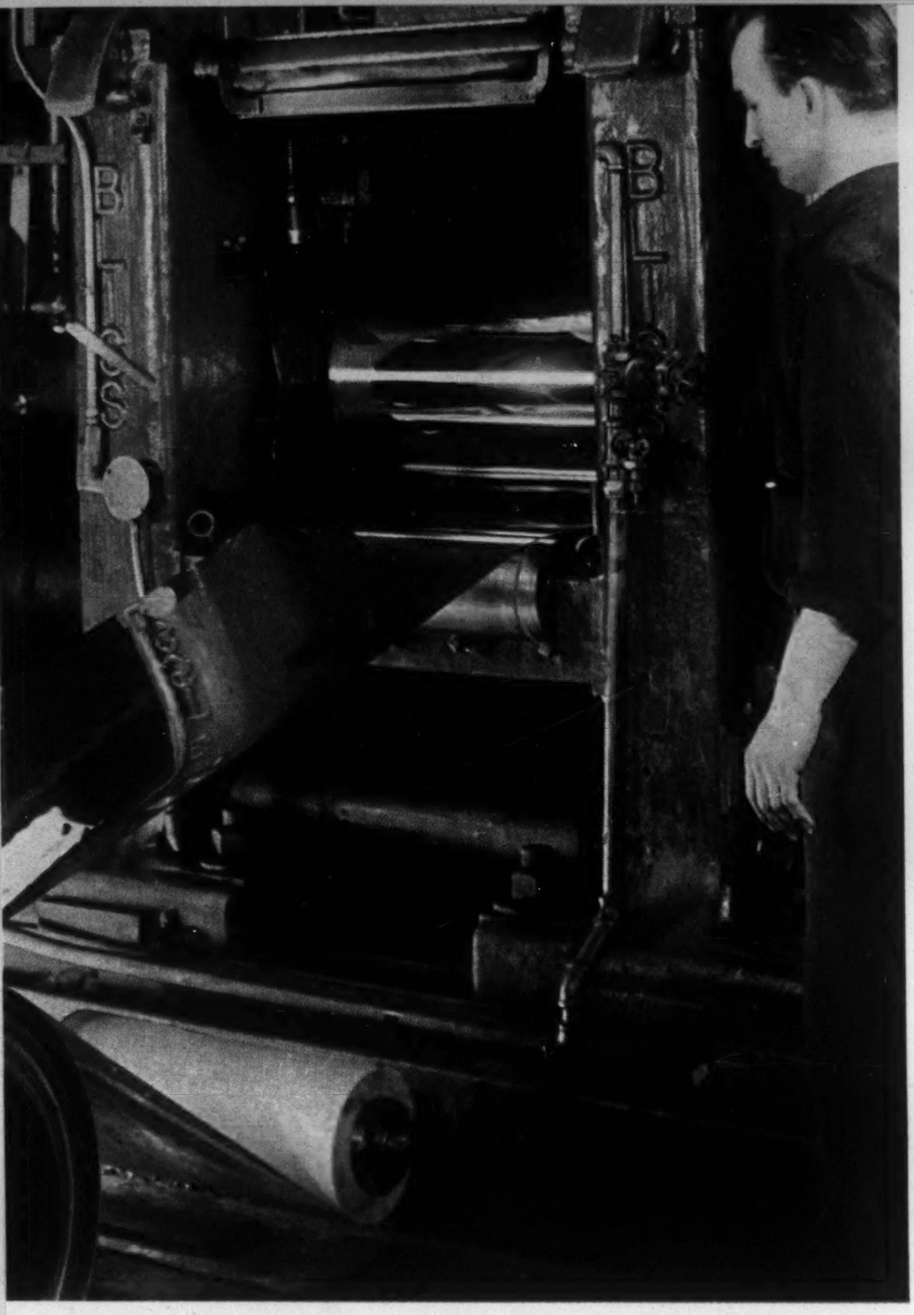
These fabricators are reducing their production costs . . . stretching supplies of hard-to-get, expensive metals . . . and making their finished products more competitive and attractive.

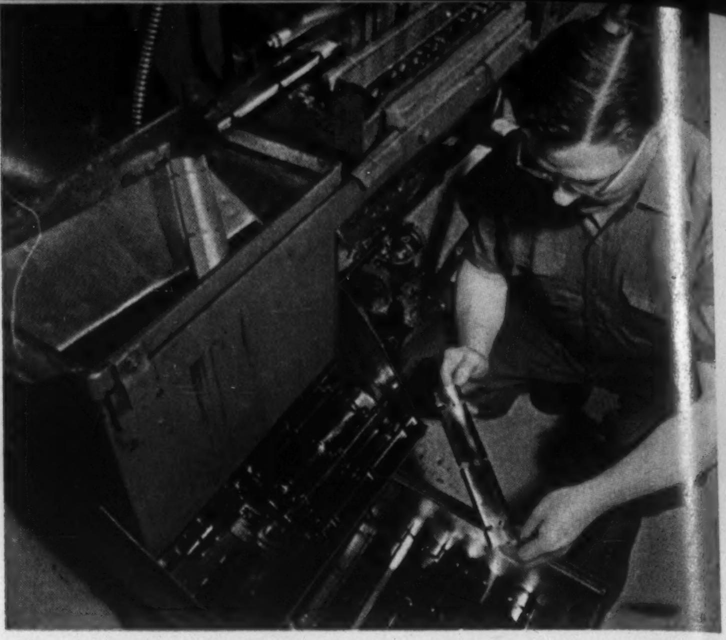
Pre-coated steel specialties from the Thomas Strip Division of Pittsburgh Steel Company come to you already electroplated with zinc, copper, brass or nickel. Or you can get them hot dip coated with lead alloy or tin. Natural, planished or buffed finishes are available. Lacquer coatings are furnished in a full range of colors or in clear lacquer. Thomas also can supply you close tolerance plain steel strip in a variety of tempers, grades and finishes.

Thomas Strip has long been recognized for precision rolling to extremely close tolerances in gages down to .004 inch and up to 22 inches in width. Tempers include 1, 2, 3, 4 and 5, or special tempers as required. You can get Thomas Strip in oscillated or ribbon-wound coils or in cut lengths. A choice of edges is available to meet your exact specifications.

Don't overlook the possibilities of Pattern Designed rolled strip which Thomas produces in an almost unlimited variety of patterns in coated and uncoated finishes. Turn the page to see how other manufacturers are cutting costs with Thomas Strip products.

HOW PRE-COATED THOMAS STRIP SAVES YOU MONEY

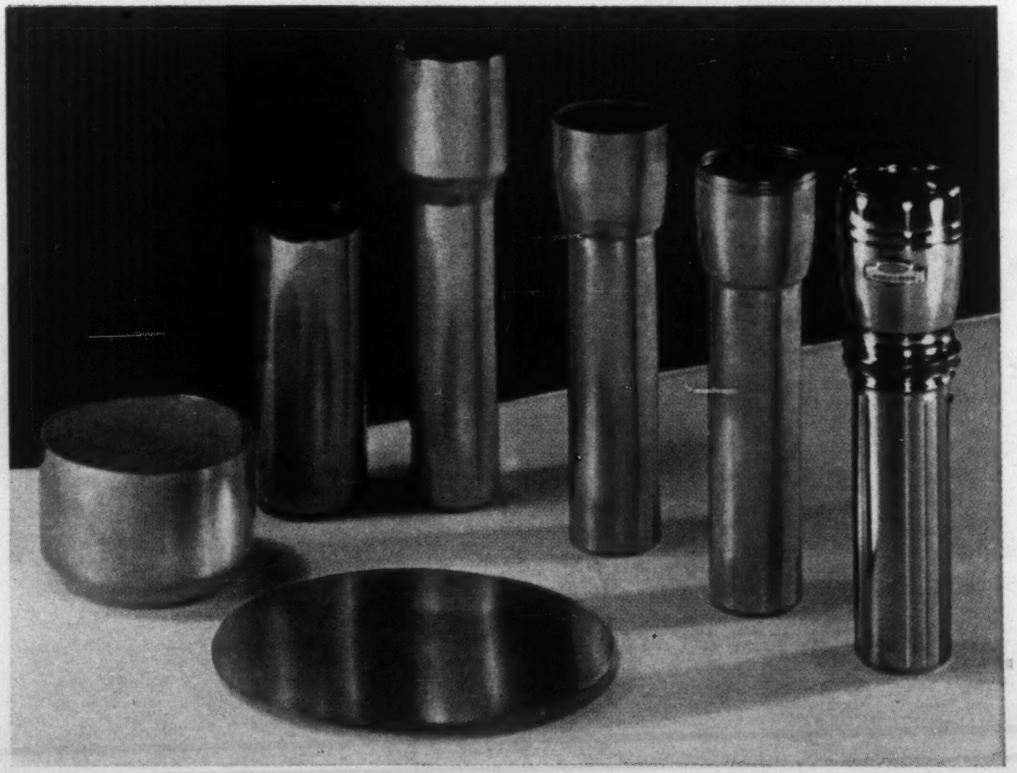




Nickel Coated Strip—Loose Leaf Metals Co. of St. Louis is one of the largest manufacturers of metal hardware for binders and loose leaf books. Photograph shows production of a metal part for a first grade ring metal. President George A. Ober says: "We have never experienced a flaky surface on a Thomas product. We've come to know Thomas will not ship until its product is right, therefore, we have never had to reject their materials." Thomas is a major supplier of cold rolled nickel, copper, tin, zinc and lacquer coated steel.

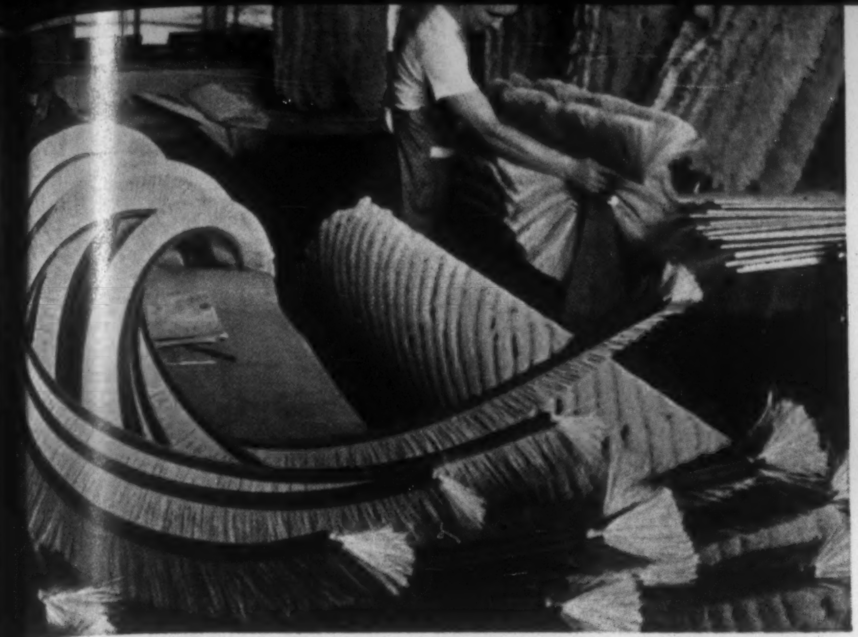
Plain Steel—Bright uncoated steel strip in low carbon, alloy and spring steel grades, has uniformity of temper, gage and finish. Above, plain cold rolled steel passes through a temper mill at the Thomas Strip plant. In addition to high finishes, Thomas Strip is available in dull and regular finishes, in coils or cut lengths—in a choice of edges—and a range of specifications.

Here's Why You Cut Costs With Thomas Strip



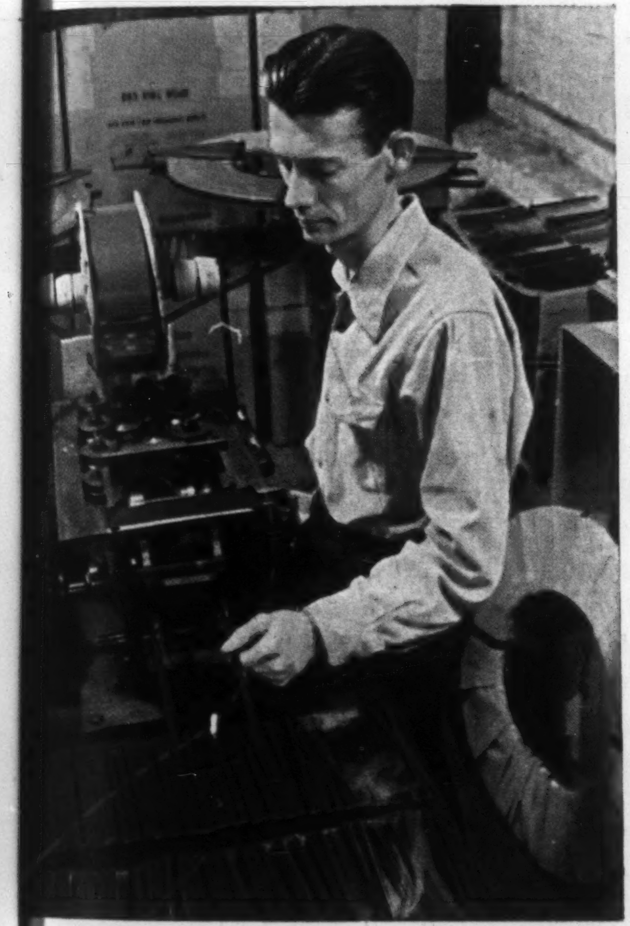
Copper Coated Strip—Here's the evolution of a Ray-O-Vac flashlight—from electroplated copper strip, produced by Thomas Strip, to the finished product. Blake Manufacturing Division of Ray-O-Vac Company at Clinton, Mass., changed from brass to steel for this and other flashlight cases. Production savings from 17 to 29 percent resulted. Ray-O-Vac uses a .020 gage, non-scalloping, deep drawing quality strip steel produced by special processing techniques. The steel is electro-copper coated on both sides, and is 6⁹⁄₁₆ inches wide. On three popular models alone, the savings amounted to more than $100,000 in one year.

- **Thomas Strip Fabricates Easily**—Coatings stand fully as much fabrication as the easy-to-work base steel.
- **Die Life Is Lengthened**—Most coatings lubricate dies, reduce wear.
- **Gives Maximum Pieces Per Pound**—Because Thomas Strip is rolled to extremely close tolerances, you get the maximum number of parts per pound of metal.
- **Cuts Plating Costs**—Thomas coatings can serve as a final product finish or as a prepared base for further plating or painting.
- **Your Manufacturing Processes Are Streamlined**—Ready-to-fabricate Thomas Strip streamlines your manufacturing processes to two essentials—fabricating and assembly.
- **Extends Economy Of Steel To Many Parts**—Pre-coated Thomas Strip replaces more expensive metals.
- **You Can Begin To Save Today**—Experienced Thomas metallurgists and technicians are available now to help you with your steel problems. Their help is yours for the asking. Write or call any Pittsburgh Steel Company sales office.



Zinc—Long "strips" of Thomas zinc-coated steel hold the vegetable fiber in Fuller Brush Co.'s power-driven brushes shown above. In foreground is an industrial brush used to process plywood. The brush in the background is for an automobile washing machine. Although zinc-coated steel undergoes a severe deformation in forming machines, this Thomas product takes the punishment easily. The heavy, uniform coating of zinc remains undamaged, giving the brushes long life.

Tin Coated Strip—International Register Co. of Chicago, producer of electrical timing devices, made approximately a 20 percent saving when it switched to Thomas pre-coated strip. Tin coated strip, like that above, provides corrosion resistance to dials, gear case covers and other timer parts. Above, Ray Gabriel, International's Steel Buyer, shows Pittsburgh Steel representative Buck Mills a completed Intermatic Time-All appliance timer.

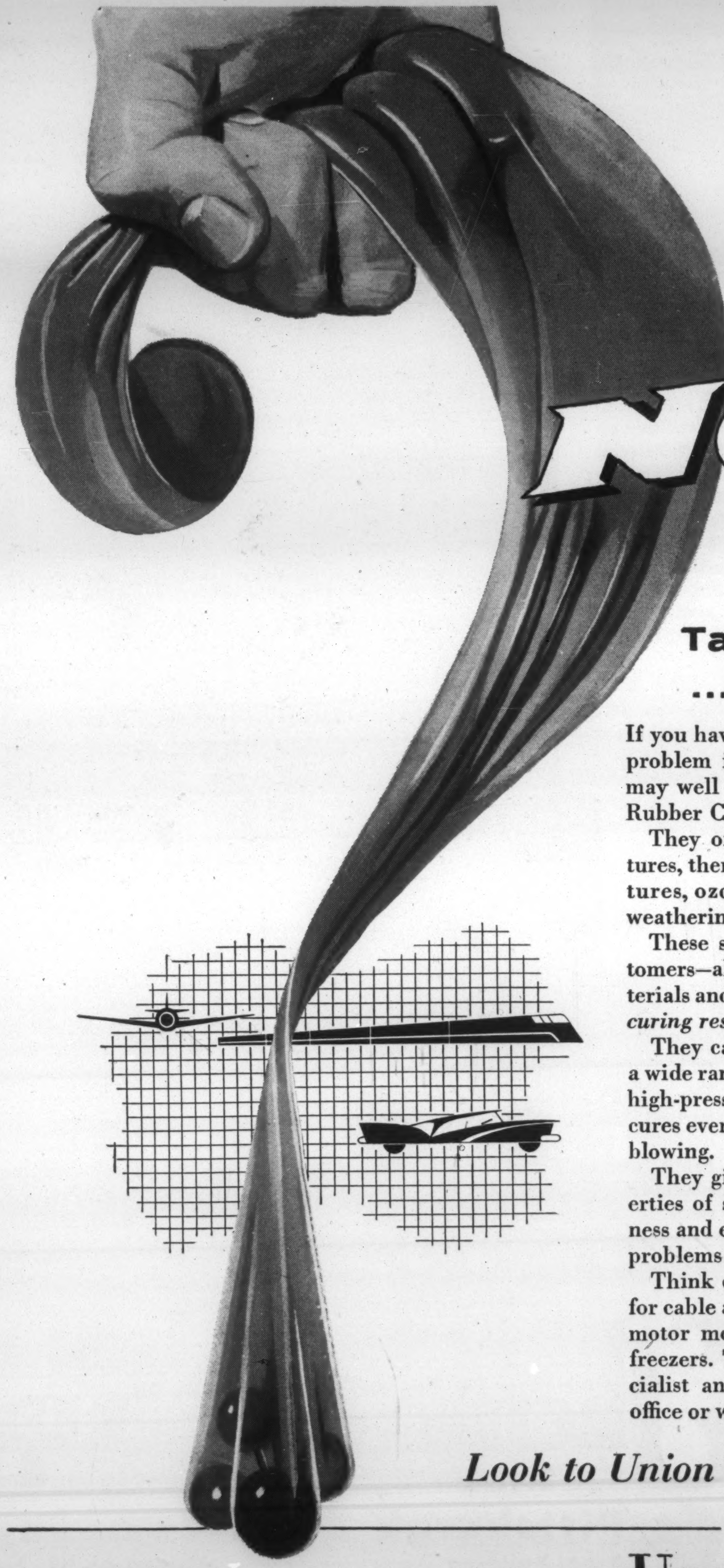


Lacquered Strip—"Nothing works as well on our machines as lacquered steel strip from Thomas," declares Max Haas, plant manager for Hinton Associates, Inc., of Staten Island, N. Y., manufacturer of Happiness Bird Cages. Hinton Associates processes blue or pink lacquered strip in the machine shown above to form a border for seed guards on its cages. Mr. Haas said: "We like Thomas lacquered strip because it doesn't break in forming machines or power presses. The zinc backing on the strip permits the rolls to get a good grip when the metal passes through our machines."

High Carbon—Thomas Strip's high carbon strip gets a tough test in the Toledo, Ohio, plant of Prestole Corp., manufacturers of steel fasteners. Prestole bends, twists, shears, punches and forms Thomas Strip's high carbon strip, as in the operation above. It has to have steel that's free of excessive burring, gives the finished fasteners the right springback and proper tension. Each coil must be uniform in chemical and physical specifications. "We've never had a complaint yet about Thomas quality," says Roy Gutzmer, plant manager.

Thomas Strip®
Division
Pittsburgh Steel Company
Grant Building • Pittsburgh 30, Pa.

District Sales Offices:
Atlanta
Chicago
Cleveland
Columbus
Dallas
Dayton
Detroit
Houston
Los Angeles
New York
Philadelphia
Pittsburgh
Tulsa
Warren, Ohio



DESIGN ENGINEERS...

NOW!

Take the guesswork out ...with Silicone Rubber!

If you have a heat, cold, electrical, flexibility, or other problem in your design and engineering work—you may well find the answer in UNION CARBIDE Silicone Rubber Compounds.

They offer phenomenal flexibility at low temperatures, thermal and oxidation stability at high temperatures, ozone resistance, abhesiveness, resistance to weathering, and good electrical and oil resistance.

These specially compounded general purpose elastomers—all of which meet or exceed Aeronautical Materials and A.S.T.M. specifications—provide *predictable curing results!*

They can give the desired low compression set over a wide range of hardnesses, for example, or exceptional high-pressure steam resistance, or the thickest section cures ever achieved without delaminating, sponging, or blowing.

They give you a new tool in controlling many properties of silicone rubber products in respect to hardness and elongation. Catalyst residue and its associated problems virtually reach the vanishing point.

Think of them in terms of your unsolved problems for cable and wire extruded coatings, for tapes, gaskets, motor mounts, or even for steam irons, stove parts, freezers. Then call in a UNION CARBIDE Silicone specialist and outline your problems. Call our nearest office or write Dept. N-6.

Look to Union Carbide for Silicones

SILICONES DIVISION

UNION CARBIDE
AND CARBON CORPORATION
30 EAST 42ND STREET UCC NEW YORK 17, N.Y.

In Canada: Linde Air Products Company, Division of Union Carbide Canada Limited
The term "Union Carbide" is a trade-mark of Union Carbide and Carbon Corporation

For more information, turn to Reader Service Card, Circle No. 382

Investigation of metal behavior in actual industrial environments is facilitated by the installation of a heat-resistant, alloy test rack containing numerous metals and alloys. Here is such a test rack, installed for a dozen carburizing cycles in a pit-type, circular Hevi-Duty furnace at Benedict-Miller, Inc., Lyndhurst, N. J.

Is performance at High Temperature Your problem?

Perhaps INCO can help you

Performance of a material at 1000°F. or above depends upon composition, structure, mechanical and other properties.

But it is the interdependence of these properties that may determine optimum performance.

INCO has tested many metals and alloys for high-temperature performance. In all sorts of plants, under actual operating conditions.

The result? Thanks to test methods initiated by INCO's High Temperature Engineering Service, we have a fund of valuable information. It includes data on load-carrying capacity, corrosion rates, resistance to scaling and other relevant information on performance of materials tested at high temperatures . . . in a wide variety of atmospheres.

We will gladly help you find answers to your high-temperature difficulties in your own plant. Fill in the coupon for a High Temperature Work Sheet . . . on which you can easily outline your problem to us.

The International Nickel Company, Inc.
67 Wall Street, New York 5, N. Y.

Please send a High Temperature Work Sheet.

Name____________________

Title____________________

Company____________________

Address____________________

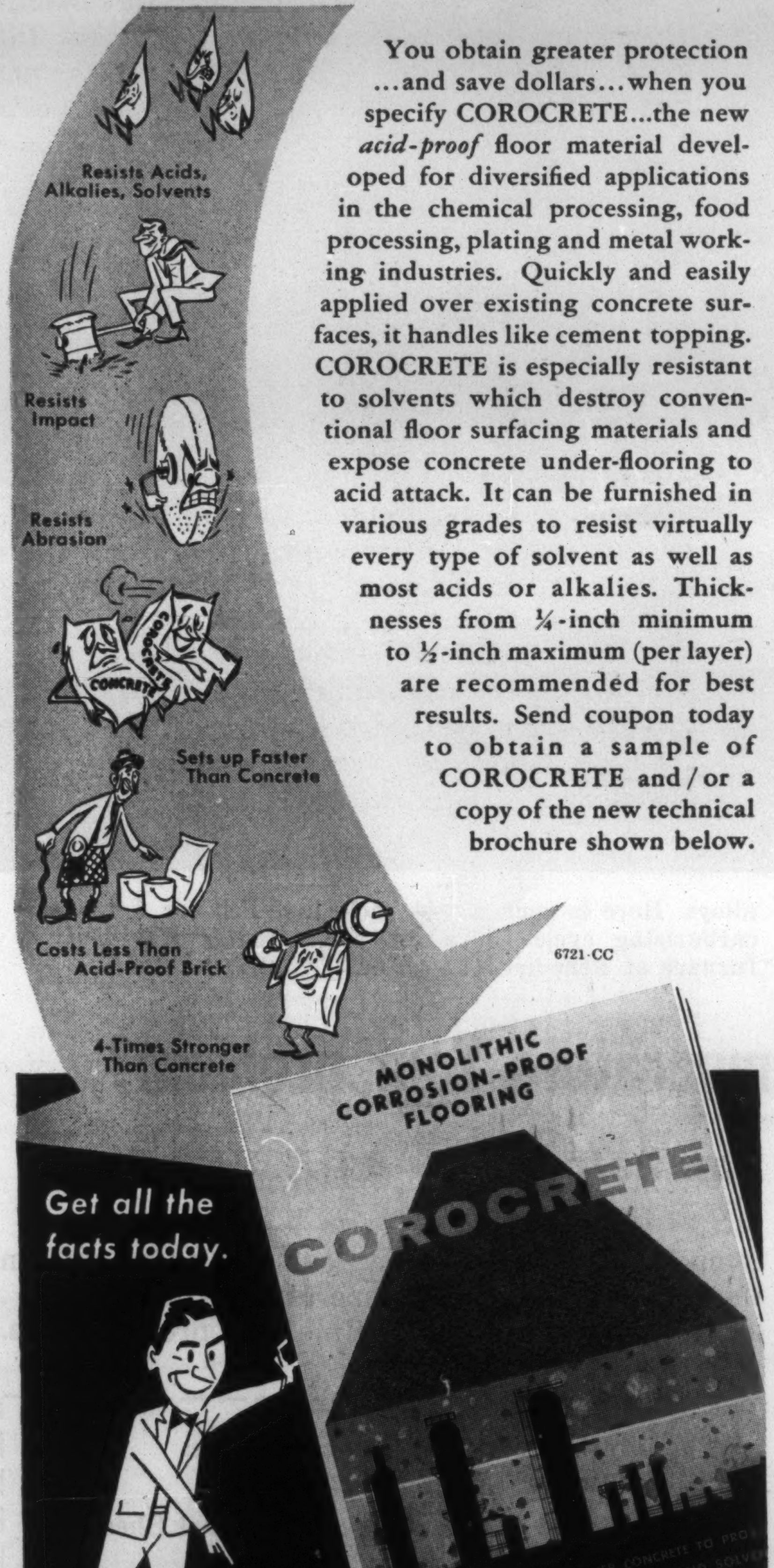
City____________ State________

INCO TRADE MARK **THE INTERNATIONAL NICKEL COMPANY, INC.** 67 Wall Street
New York 5, N.Y.

• **For more information, turn to Reader Service Card, Circle No. 375**

COROCRETE

A NEW CORROSION-PROOF SURFACING FOR FLOORS


Resists Acids, Alkalies, Solvents
Resists Impact
Resists Abrasion
CONCRETE
Sets up Faster Than Concrete
Costs Less Than Acid-Proof Brick
4-Times Stronger Than Concrete
Get all the facts today.
MONOLITHIC CORROSION-PROOF FLOORING
COROCRETE
DEVELOPED FOR APPLYING OVER CONCRETE TO PROVIDE PROTECTION AGAINST ACIDS, ALKALIS AND SOLVENTS

You obtain greater protection ...and save dollars...when you specify COROCRETE...the new *acid-proof* floor material developed for diversified applications in the chemical processing, food processing, plating and metal working industries. Quickly and easily applied over existing concrete surfaces, it handles like cement topping. COROCRETE is especially resistant to solvents which destroy conventional floor surfacing materials and expose concrete under-flooring to acid attack. It can be furnished in various grades to resist virtually every type of solvent as well as most acids or alkalies. Thicknesses from ¼-inch minimum to ½-inch maximum (per layer) are recommended for best results. Send coupon today to obtain a sample of COROCRETE and/or a copy of the new technical brochure shown below.

6721-CC

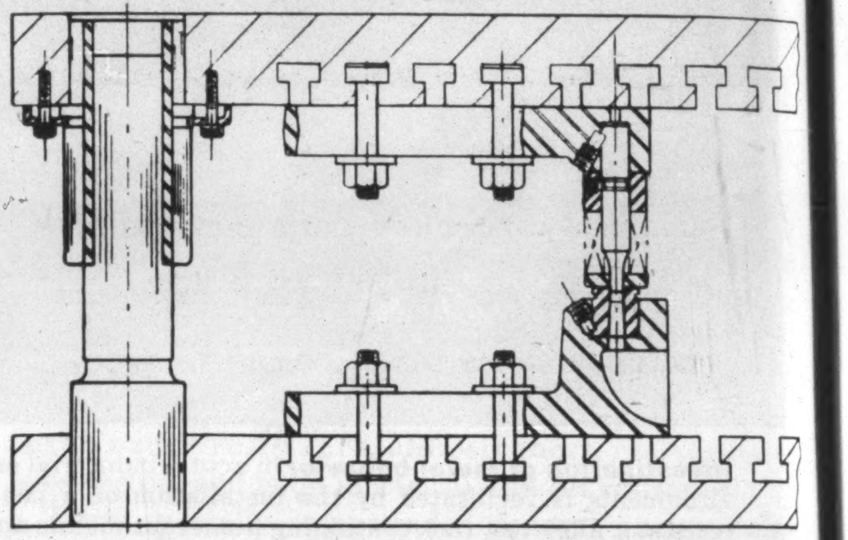
THE CEILCOTE COMPANY, INC.
4899 Ridge Road
Cleveland 9, Ohio

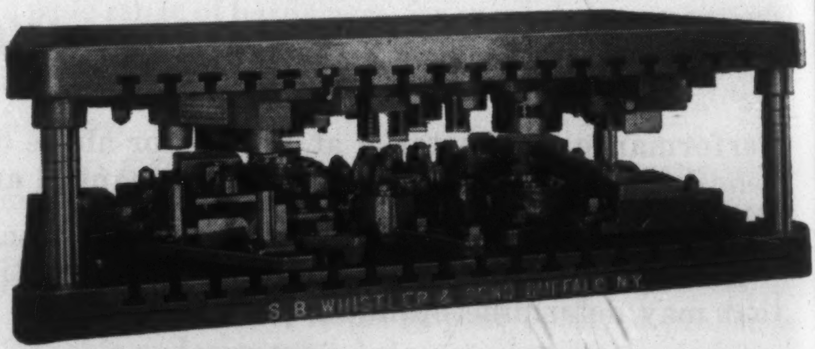
The Ceilcote Co., Inc.
4899 Ridge Road • Cleveland 9, Ohio
Check one or both:
☐ Please send me a copy of the Brochure.
☐ Please send me a sample of COROCRETE.
Name________________
Address________________
City________ Zone____ State_______

For more information, turn to Reader Service Card, Circle No. 495

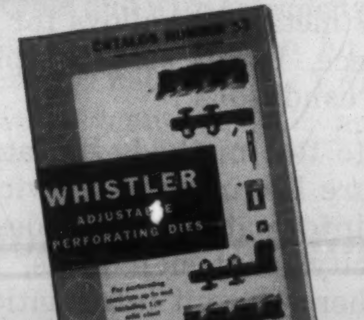
ADJUSTABLE DIES *by WHISTLER*

• Operate like a single purpose die • Easy to set-up and make changes • Interchangeable and re-usable parts always ready for a new job • Reduce die costs to a new low • Pierce holes in any desired arrangement of shapes and sizes • Precision piercing of materials to ¼" thick steel.




S. B. WHISTLER & SONS BUFFALO N.Y.

Above: Sectional drawing of a Whistler adjustable punch and die unit assembled in T-slot die set. **Below:** A completely assembled Whistler adjustable die ready for the press.


CATALOG NUMBER 57
WHISTLER
ADJUSTABLE PERFORATING DIES

YOU NEED THIS CATALOG

to see for yourself in dollars and cents what this adjustable die making method can do for your plant. Send for it right now...without obligation.

S. B. WHISTLER & SONS, INC.
741 Military Road, Buffalo 23, N.Y.

ADJUSTABLE, MAGNETIC and CUSTOM DIES FOR ALL INDUSTRY
Direct Factory Representatives Located in Principal Industrial Areas

For more information, turn to Reader Service Card, Circle No. 540

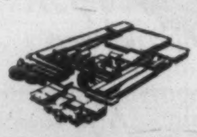
RICHARDSON

helps improve molded auto parts

⁂ Each of the molded parts pictured here had specifications which called for special materials often with unusual properties. All called for creative design approaches, both by customer and Richardson.

Richardson engineers, specialists in both molded and laminated plastics, will welcome the opportunity to help you. Write or phone for additional information.

THE RICHARDSON COMPANY
FOUNDED 1858
2782 Lake St., Melrose Park, Ill. (Chicago District)

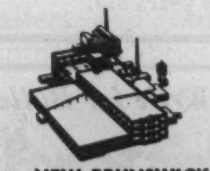


MELROSE PARK, Ill.

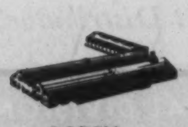
INDIANAPOLIS, IND.

NEWNAN, GA.

SALES OFFICES IN PRINCIPAL CITIES

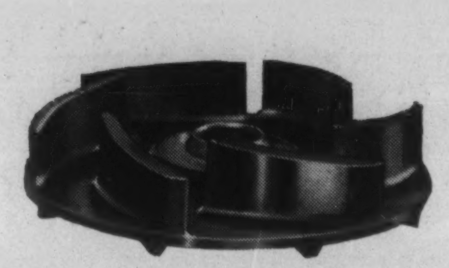


NEW BRUNSWICK N. J.

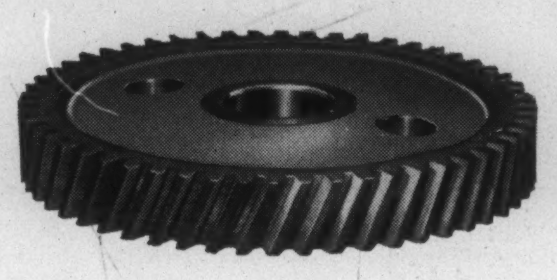


OGDEN, UTAH

TYLER, TEXAS

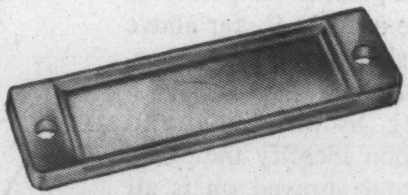


. . water pump impeller A special moisture resistant phenolic was specified for this part which must withstand the extremes of both high heat and intense cold, as well as strong torque action plus corrosion and cavitation resulting from the circulation of water in the car's cooling system.



. . timing gear The molded blank of this gear had to have high flexural characteristics . . also a good bond in the laminate section for ease in cutting gear teeth, and to insure necessary tooth strength. The manufacturer and Richardson developed a new material with high heat resistance. Result: Fine flexural strength in the web section . . more quiet operation . . . easier fabrication . . . easier assembly . . . *tripled gear life!*

. . radio antenna mast base This part had to have good surface appearance, high impact strength, high dielectric strength, and at the same time be weather resistant. A black phenolic material with an attractive high gloss finish was recommended.



. . dashboard light lens Originally this part was designed as a clear lens. Later, when the specifications were changed to call for a translucent lens, the customer suggested that either the mold, or the clear parts, be sandblasted . . either process would have increased costs. Richardson suggested, instead, a special light-transmitting polystyrene. Result: 15% reduction in lens cost.

RICHARDSON PLASTICS

MOLDED AND LAMINATED

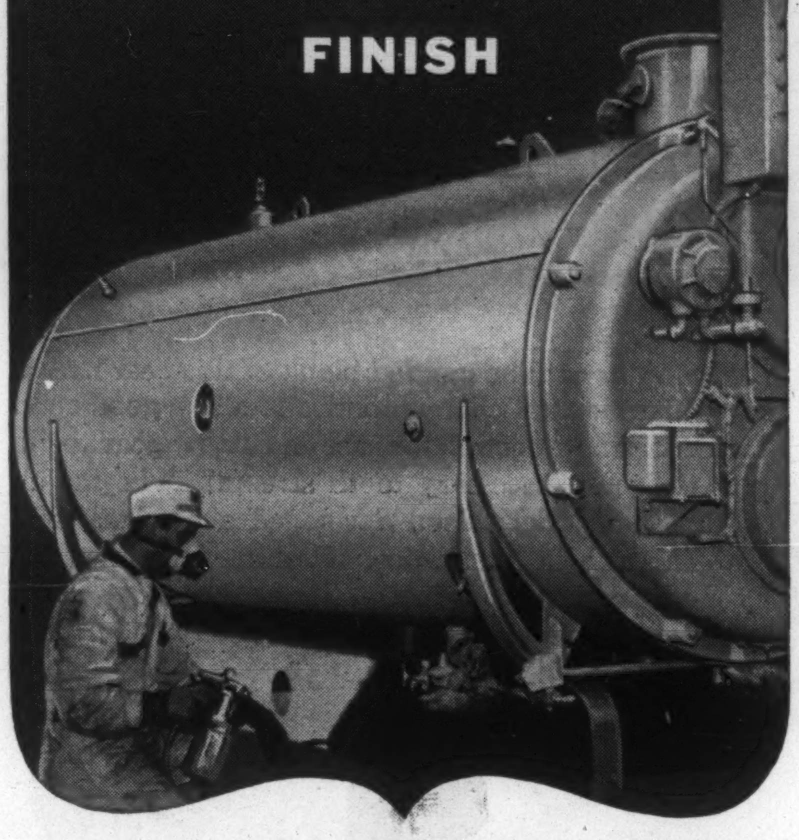
• **For more information, turn to Reader Service Card, Circle No. 479**

Sicon®

the original SILICONE

HIGH TEMPERATURE

FINISH



chosen for CLEAVER-BROOKS

"CB" line of packaged boilers

SICON has reduced finishing costs for Cleaver-Brooks and provided a longer lasting finish that retains its color and gloss at temperatures in the range of 500° F., far above the hottest skin temperatures normally encountered.

Sparkling SICON Gray and SICON Maroon identify the "CB" line. One coat sprayed on is all that is required. It air-dries fast and maintains its attractive colors and protective qualities for the life of the unit.

For a silicone heat resistant finish that has stood the test of heat and time, write for the *complete* SICON story! Dept. F-1.

RETAINS COLOR AND GLOSS

FAST DRYING

EASY TO APPLY

SICON® *is manufactured exclusively by*

MIDLAND *Industrial Finishes Co.*
EAST WATER ST., WAUKEGAN, ILLINOIS
ENAMELS SYNTHETICS LACQUERS VARNISHES

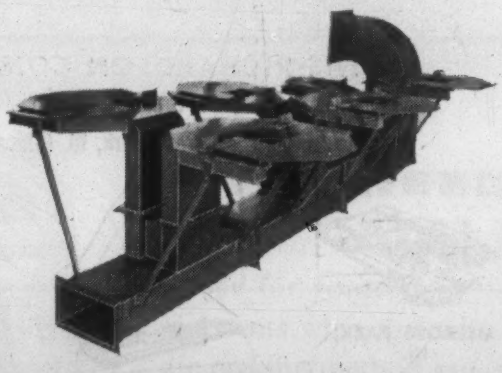
For more information, turn to Reader Service Card, Circle No. 531

Corrosion Conquered by *Van-Cor* DUCTS

OLD METHOD—To exhaust fumes from their plating department, a bearing manufacturer used metal coated ducts. Corrosion destroyed them in eight months.

NEW METHOD—Van-Cor Ducts shown above have already served three years—*four times longer*—and are as good as new!

An unplasticized polyvinyl chloride, Van-Cor has licked scores of corrosion problems. Van-Cor is fabricated into ducts, hoods, chemical tanks, stacks, etc. Also available in pipe, fittings and valves. Both Chemically Resistant and Impact Resistant types. Van-Cor has only half the weight of aluminum, yet has high tensile strength.



Intricate Van-Cor hood and duct for exhausting acid fumes while reclaiming precious metals. Previous duct materials were replaced every two months. This Van-Cor fabrication is over two years old.

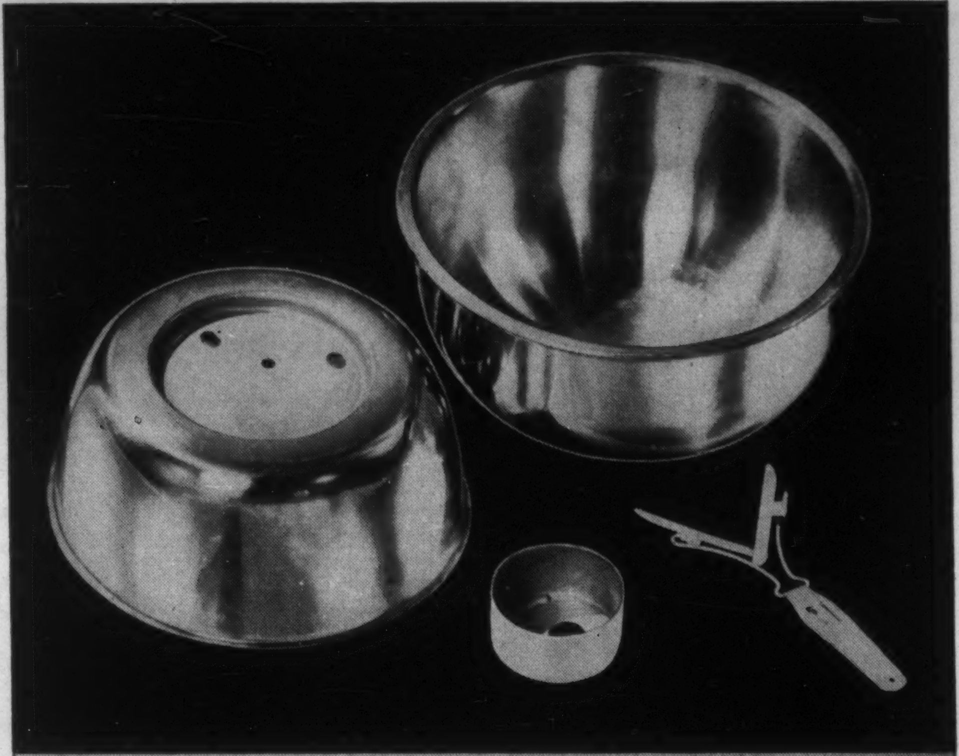
INVESTIGATE!

Write for Bulletin, Specifications and Name of Nearest Distributor.

INDUSTRIAL DIVISION OF
COLONIAL PLASTICS MFG. CO.
SUBSIDIARY OF THE VAN DORN IRON WORKS CO.
2685 EAST 79th STREET • CLEVELAND 4, OHIO

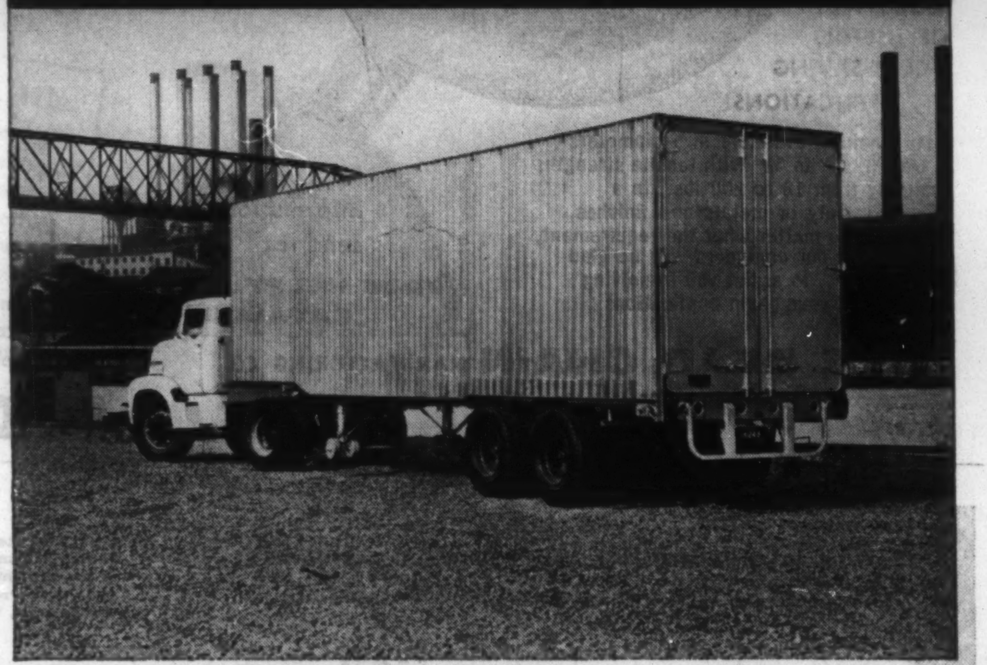
For more information, turn to Reader Service Card, Circle No. 397

You can draw and form them LITTLE



• • • • • • • • • • • • • • •

or fabricate them BIG



with the new A-L low-nickel STAINLESS GRADES

WRITE FOR THE ASSISTANCE YOU NEED

1. "TECHNICAL STUDIES #3"

. . . essential information on the composition, properties, fabricating methods and applications of AL chromium-manganese, low-nickel stainless steels. *Write for your copy.*

2. TEST SAMPLES

. . . We'll be glad to supply engineering assistance, and actual samples of these 200-Series steels for testing under your processes and conditions.

ADDRESS DEPT. MM-78

In the top photograph, the fabrications you see are a mixing bowl, a tea-kettle base, a lock case and a patented shoe fastener: all made of A-L Type 201 or 202 chrome-manganese low-nickel stainless. The finish is good, the steel handled the same in the presses as Types 301 or 302, and similar drawing, buffing and polishing procedures were followed.

As in the lower illustration, the chrome-manganese low-nickel grades are being used also for fabrications as large as truck trailers and railroad coaches. Again, forming qualities and weldability present no problems, and results are entirely satisfactory.

Sum it all up and this is the answer: you *won't* encounter any particular differences in fabricating the 200-series of stainless steels . . . you *will* find some advantage in price, and a very important factor of much greater availability in times of nickel shortage. ● Why not take advantage of our pioneering experience with the low-nickel grades—let us help you use them. *Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.*

For Stainless Steel in ALL Forms—call

Allegheny Ludlum

AL STAINLESS STEEL ®

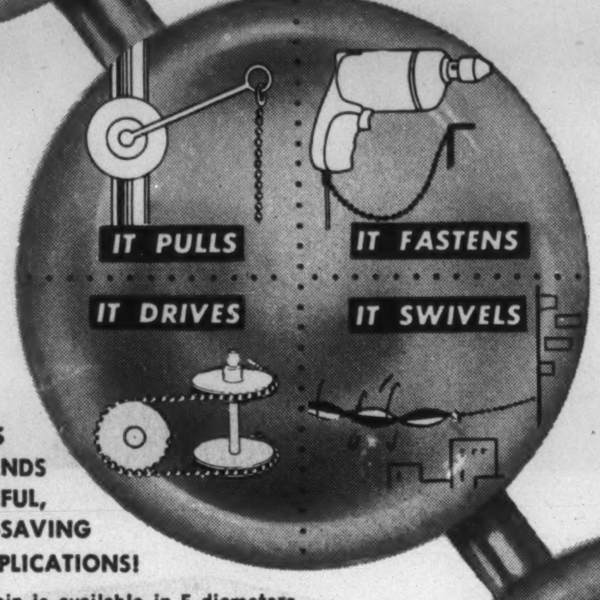
Warehouse stocks carried by all Ryerson Steel plants

• **For more information, turn to Reader Service Card, Circle No. 548**

For more information, turn to Reader Service Card, Circle No. 392

take advantage of *Versatile*

BEAD CHAIN



IT HAS THOUSANDS OF USEFUL, COST-SAVING APPLICATIONS!

Bead Chain is available in 5 diameters from 3/32″ to ⅜″ with tensile strengths ranging from 18 to 200 lbs., in a variety of metals and finishes. No matter what the requirement, our engineers will be glad to assist you in solving your chain applications.

For complete information send for **FREE HELPFUL CATALOG**

THE BEAD CHAIN MANUFACTURING CO.
15 Mountain Grove St., Bridgeport, Conn.

For more information, turn to Reader Service Card, Circle No. 388

add unrivalled prestige to your product with

Electroplated GOLD FINISH

Cost of electroplating gold is fully in line with your other production costs — yet brilliant tarnish-proof gold adds permanent richness and intrinsic value attainable no other way.

Technic Inc. equips you to maintain exacting standards and close tolerances. We design your installation for electroplating gold without waste — and our engineers stand by until performance is assured. Consult us without obligation, in respect to new installation or an existing system now in use.

Att: **DESIGNERS**
Electroplated gold is recommended as complete over-all finish for toasters, percolators, clocks, small radios, etc. — as well as for decorative accents on appliances of all sizes. Mild damp-cloth cleansing retains beauty of gold finish indefinitely. Write for "Electroplated Gold" data sheet.

TECHNIC INC. PRODUCTS OF RESEARCH

TECHNIC, INC.
39 Snow St.
Providence, R. I.
JAckson 1-4200

Chicago Office — 7001 North Clark Street

THE LARGEST ENTERPRISE OF ITS KIND IN THE WORLD

REDUCE PRODUCTION COSTS

use **Roll Formed Stock**

- STRIP
- ROD
- TUBING

Brass
Stainless Steel
Copper
Inconel
Aluminum
Nickel
Stainless Steel
Brass
Beryllium Copper
Leaded Brass

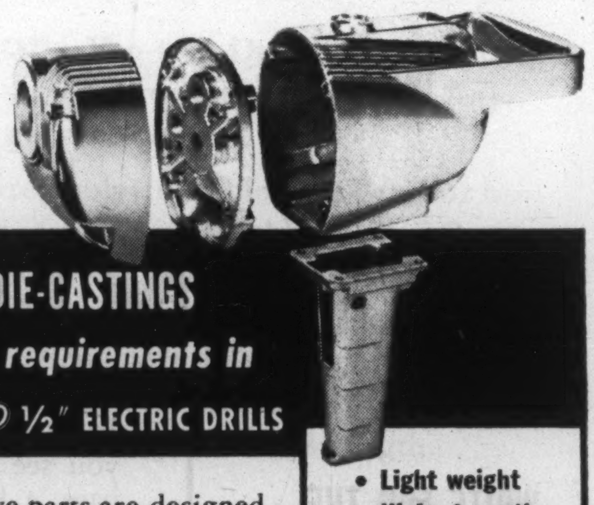
Machining or Milling Operations-Scrap Losses and Labor Eliminated or Minimized. Some Sizes, Shapes, Tolerances as Tight as .001.

Ferrous-Non Ferrous Metal. Send Print or Sketch for Estimate Roll Costs and Material Costs.

MAKEPEACE
D. E. MAKEPEACE COMPANY
Division of Union Plate and Wire Co.
Attleboro, Mass.

For more information, turn to Reader Service Card, Circle No. 407

Photo courtesy
Fairchild Camera & Instrument Corp.
Electrical Products Div.
Burlington, Vt.



DOLLIN DIE-CASTINGS
meet critical requirements in
FAIRCHILD ½″ ELECTRIC DRILLS

- Light weight
- High strength
- Compactness
- Accuracy
- Appearance
- Low cost

These attractive parts are designed and die-cast to gain the highest strength-to-weight ratio of aluminum, plus maximum surface uniformity.

Dollin achieved this by constant control of alloy purity during casting, to produce a dense, sound structure and smooth surface. This permitted thinner walls, reducing weight and bulk; also low-cost polishing in a single operation by the "Roll Brite" method. All parts are die-cast, trimmed and sanded by Dollin—require little additional machining—match accurately for easy assembly.

● Get the most out of your die-casting designs by consulting Dollin engineers. Submit prints or samples for engineering advice or quotation.

DOLLIN CORPORATION
610 So. 21st St.
Irvington 11, N. J.

DOLLIN
Zinc and Aluminum
DIE-CASTINGS

For more information, turn to Reader Service Card, Circle No. 401

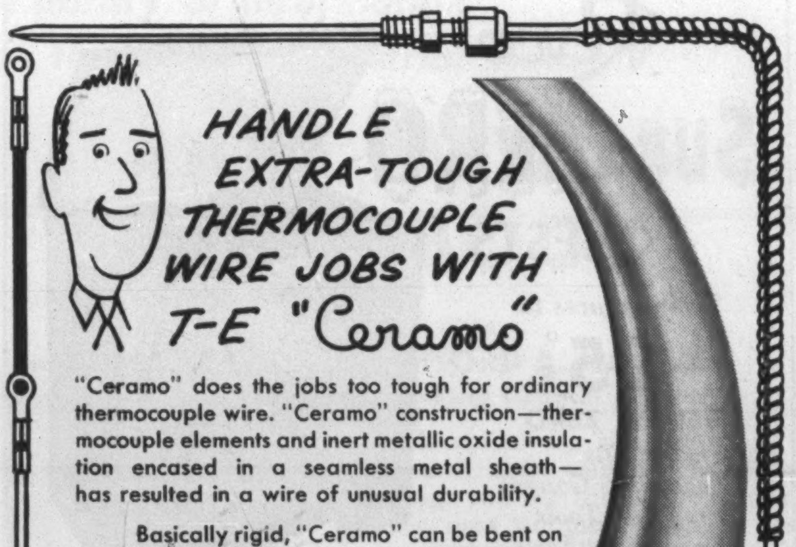
For more information, turn to Reader Service Card, Circle No. 365

BLACK LIGHT INSPECTION CUTS REJECTS TO ZERO!

Rejects caused by inadequate coverage of protective coatings and transparent finishes are being eliminated by an economical *invisible* system known as Blak-Ray. Manufacturers report major savings in inspection costs.

Under ordinary light, "misses" are virtually undetectable. Under black light ultra-violet, a fluorescent additive in the coating makes inspection rejects a thing of the past.

Full information is contained in new Case History 115M, available from the BLACK LIGHT CORPORATION OF AMERICA, Distributors for Ultra-Violet Products, Inc., 5114 Walnut Grove Avenue, San Gabriel, California. Distributors in principal cities.


HANDLE EXTRA-TOUGH THERMOCOUPLE WIRE JOBS WITH T-E "Ceramo"

"Ceramo" does the jobs too tough for ordinary thermocouple wire. "Ceramo" construction—thermocouple elements and inert metallic oxide insulation encased in a seamless metal sheath—has resulted in a wire of unusual durability.

Basically rigid, "Ceramo" can be bent on an extremely small radius without shorting or grounding. Enclosed "Ceramo" thermocouples last longer and respond faster than conventional types. Available in all standard calibrations. Depending on conductors and sheath material, "Ceramo" can be used up to 3000°F. Sheath for T/C wires—Stainless Steels, Inconel, tantalum and platinum. For T/C extensions—copper-nickel alloy, plain or galvanized cold-drawn steel.

WRITE FOR BULLETIN 31-300- G.

Thermo Electric Co., Inc.
SADDLE BROOK, NEW JERSEY
In Canada—THERMO ELECTRIC (Canada) Ltd., Brampton, Ont.

For more information, turn to Reader Service Card, Circle No. 519

For more information, turn to Reader Service Card, Circle No. 440

● **we are**

manufacturers

. . . . *NOT JOBBERS!*

of rigid

CAST ACRYLIC PLASTIC SHEETS

ANY THICKNESS OR SIZE
FIRST GRADE OR "R" GRADE

We specialize in closer tolerance and harder surface for greater abrasion resistance.—Also other special formulations.

If you are a fabricator, jobber, or end user, contact us for immediate delivery from stock.

A SECOND SOURCE OF SUPPLY IS INVALUABLE

See us at Booth 113

CAST OPTICS
CORPORATION
127 Newman St.
Hackensack, N. J.
HUbbard 9-4000

Manufacturers of COCOR • BRAND Plastic Sheets

COCOR* Registered Trademark of Cast Optics Corp.

LOOKING FOR

★ **Heat Dissipation?**

★ **Free Machining?**

★ **Bearing Properties — etc?**

The *Alumibond* Process

May be Your Answer!

ALUMIBOND molecularly bonds ALUMINUM and its alloys to the ferrous metals. This new casting process can solve your problems involving heat transfer, joining, weight saving, oxidation resistance, bearing surfaces, etc.

Write Today for ALUMIBOND Brochure and Complete Information!

Arthur Tickle Engineering Works, Inc.
21-M Delevan Street
Brooklyn 31, N. Y.

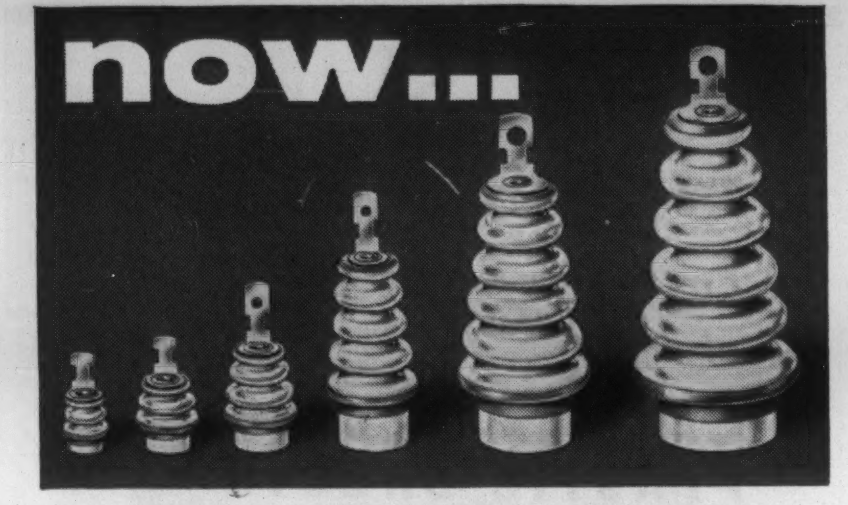
Please send ALUMIBOND Brochure to:

Name____________________________
Address__________________________
City____________ Zone______ State________

For more information, turn to Reader Service Card, Circle No. 419

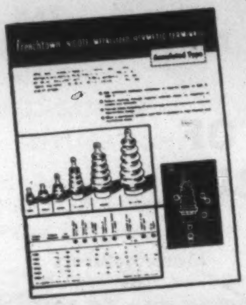
For more information, turn to Reader Service Card, Circle No. 408

now...



Frenchtown Metallized Terminals!

Here is Frenchtown's improved line of Annuluted Type NICOTE Metallized Hermetic Terminals for use in controls, relays, transformers, capacitors, motors, and heater units. Custom-engineered of HIGH ALUMINA CERAMICS and metallized with our exclusive NICOTE, these terminals are available in six varying sizes with a choice of terminal hardware to fit any exacting application. Write for Engineering Bulletin 1055.



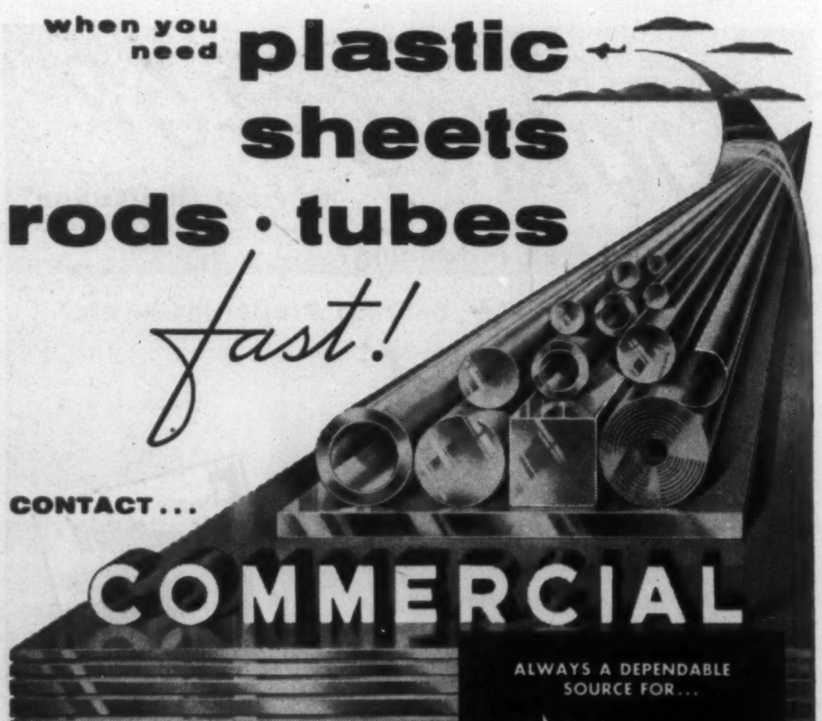
frenchtown PORCELAIN COMPANY
84 Muirhead Avenue | Trenton 9, New Jersey

---

when you need **plastic sheets rods · tubes** *fast!*

CONTACT...

COMMERCIAL



ALWAYS A DEPENDABLE SOURCE FOR...

- ROHM & HAAS PLEXIGLAS
- DU PONT NYLON
- DU PONT LUCITE
- DU PONT TEFLON
- BAKELITE VINYLITE
- ST. REGIS PHENOLIC LAMINATES
- DU PONT POLYETHYLENE
- CELANESE ACETATE
- DOW POLYSTYRENE

HERE AT COMMERCIAL . . . This we can assure you . . . Whether you need a short rod of Phenolic Laminate or a truckload of Plexiglas sheets . . . you get the plastic you want . . . *fast* . . . in any desired size, thickness, color and quantity. COMMERCIAL is the industry's largest, most completely dependable source for plastic sheets, rods, tubes and film.

Write for New "Plastic Properties Chart MM"

COMMERCIAL
Plastics & Supply Corp.
630 Broadway, N.Y. 12, N.Y.
Phone: GRamercy 7-5000

OFFICES
Miami, Fla., 449 W. Flagler Street
Greensboro, N.C., 1039 Westside Dr.
Pittsburgh, Pa., 119 - 19th Street

Visit Our Booth 525, Seventh National Plastics Exposition, New York City, June 11-15

For more information, turn to Reader Service Card, Circle No. 423

For more information, turn to Reader Service Card, Circle No. 437

you need

MOLYKOTE® Lubricants

IF YOU HAVE LUBRICATION PROBLEMS IN THESE APPLICATIONS

CHECK OFF THE ONES WHICH ARE GIVING YOU TROUBLE

- ☐ EXTREME BEARING PRESSURES
- ☐ EXTREME TEMPERATURES
- ☐ UNUSUAL ENVIRONMENT
- ☐ MATING SURFACES OF SAME OR SIMILAR MATERIALS
- ☐ FRETTING
- ☐ HIGH STARTING FRICTION
- ☐ RUBBER ON METAL
- ☐ LIFETIME LUBRICATION
- ☐ RESISTANCE TO CENTRIFUGAL FORCE

Even if you have checked only one of these sources of lubrication problems, you need MOLYKOTE. Tell us which ones you have checked and we will mail you pertinent literature.

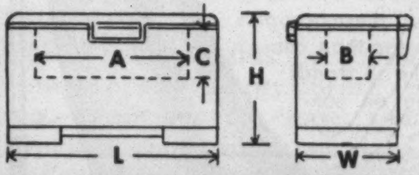
The **ALPHA MOLYKOTE** *Corporation*
Main Factories: 67 Harvord Avenue, Stamford, Conn.
71 Arnulfstrasse, Munich 19, Germany

Revco

SUB-ZERO CHESTS

Temperatures to
-95° F
BELOW ZERO

For Shrink Fits
Seasoning Gauges
Precision Tools
Laboratory Tests



SUB-ZERO MODEL SZH-153 Shown
REVCO RIVET COOLER with 90 Rivet Cannisters available

Special Equipment added to meet Your Needs, if desired.

MODEL	CU. FT.	TEMP. PULL DOWN 70° RM	CAPACITY Inside (") A	B	C	OUTSIDE Dimen. (") L	W	H	Hermetic UNITS* HP
SUB-ZERO SZH-153	1.5	-95°F	23	9	12½	42	28	43	½ & ¼
SUB-ZERO SZH-653	6.5	-85°F	47	15	16	60	28	43	½ & ¼
RIVET COOLER RSZ-503	5.0	-30°F	30	16	18	42	28	41	¼

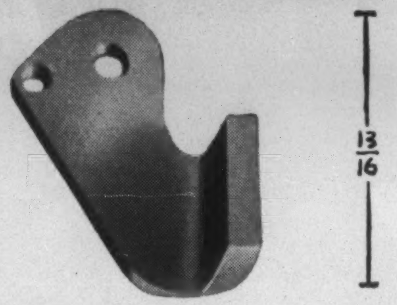
*Fan Cooled; Refrigerant F22 and F12; Current 110/60 • WRITE TO:

REVCO INC. . . . DEERFIELD, MICH.

For more information, turn to Reader Service Card, Circle No. 417

For more information, turn to Reader Service Card, Circle No. 414

STAMPINGS
IN SMALL LOTS



This sketch briefly describes the cost of typical parts made for one of our earliest customers, whom we have served for the past thirty-four years.

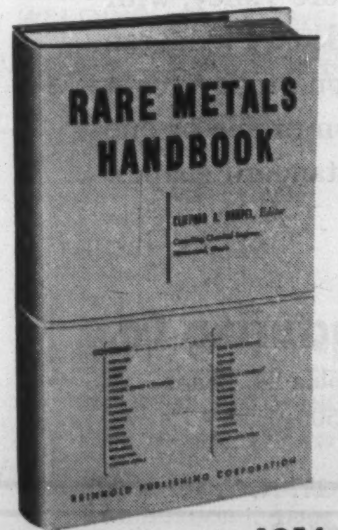
EXAMPLE
MATERIAL: C. R. STEEL
The cost of blanking, piercing, drilling and deburring, including all tools:
First 100 pieces............$49.50
Each add'l. 100 pieces....... 8.50
Plus actual cost of material used for stampings.

We have the nation's very best facilities and know-how to produce short-run stampings at the lowest possible cost. Send your sketch, blueprint, or part, plus quantity, for prompt quotation.

DAYTON ROGERS
Manufacturing Company
MINNEAPOLIS 7X, MINNESOTA

A library of information on the newest industrial metals!

RARE METALS HANDBOOK



1954,
668 pages,
$12.00

edited by
CLIFFORD A. HAMPEL
Consulting Chemical Engineer

Compiled by a large staff of experts, this valuable handbook brings you the full range of available data on more than 35 less-common metallic elements. Included are all of the new "glamor" metals that are playing such an increasingly important role in modern technology.

Information about each element is arranged for speedy reference to such important aspects as occurrence, production statistics, economics, derivation, physical and chemical properties, fabrication techniques, and present and potential uses. Properties and comparisons between metals are shown in convenient tabular form wherever possible, and unusually complete reference lists close every chapter.

Order now for 10 days' FREE EXAMINATION
REINHOLD PUBLISHING CORPORATION
Dept. M-951, 430 Park Avenue, New York 22, N. Y.

For more information, turn to Reader Service Card, Circle No. 583

For more information, turn to Reader Service Card, Circle No. 464

Parts made of
Dixon RULON
never need lubrication
Specify RULON for –
- VERY LOW FRICTION
- HIGH WEAR RESISTANCE
- GREAT CHEMICAL INERTNESS
- EXCELLENT DIELECTRIC PROPERTIES
- GOOD HEAT PROPERTIES UP TO 350°-500°F

Rulon is inherently slippery, requires no lubrication. This remarkable plastic offers most of the advantages of Teflon but has far greater wear resistance and better resistance to cold flow.

If you need one or all of Rulon's special properties for bearings, bushings, slides, guides, cam followers, washers, spacers, or other parts — consult us without obligation.

We supply both Rulon and Teflon in rods, tubes, sleeving, tape, extruded and molded shapes. Write for detailed information.

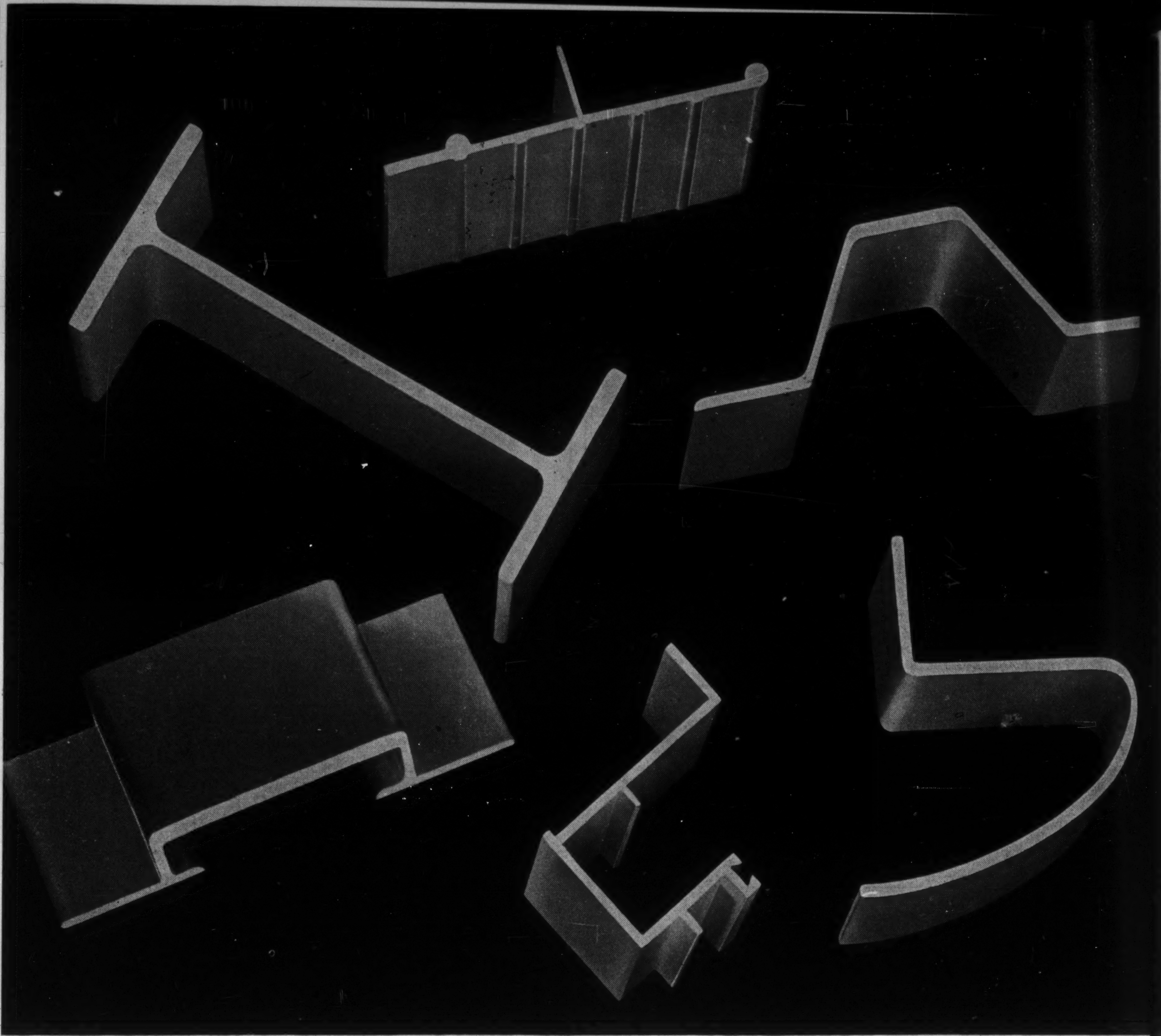
DIXON CORPORATION
BRISTOL 4, RHODE ISLAND

You, too, can save thousands of dollars with
GPX
PLASTIC SURFACED PLYWOOD
- Satin smooth
- Tough and abrasion resistant
- Moisture resistant
- Acid and heat resistant
- Vermin resistant
- Easy to fabricate
- Needs no finishing

Send for Technical Manual.

GEORGIA—PACIFIC
PLYWOOD COMPANY
270 Park Avenue, New York 17, N. Y.

For more information, turn to Reader Service Card, Circle No. 421



There's more to an Extrusion than shape

The profile is only the start of a good extrusion. The chosen alloy and temper must be "right" for its job . . . equal to the stresses, strains, temperature variations and all the other physical conditions the finished product must face. Placement of metal must be accurately determined for maximum strength and minimum weight.

You get service like this, when your aluminum extrusions are made at Flynn. Skilled engineers and metallurgists put their years of experience at your command. Rigid inspection and step by step control are the rule at Flynn to make your extrusions high in quality, at lowest possible cost.

Located in the heart of the Delaware Valley, with rail and truck facilities at the door, Flynn can offer fast delivery. Write or phone today for a prompt estimate . . . on your own profile or one from stock dies in hundreds of standard shapes.

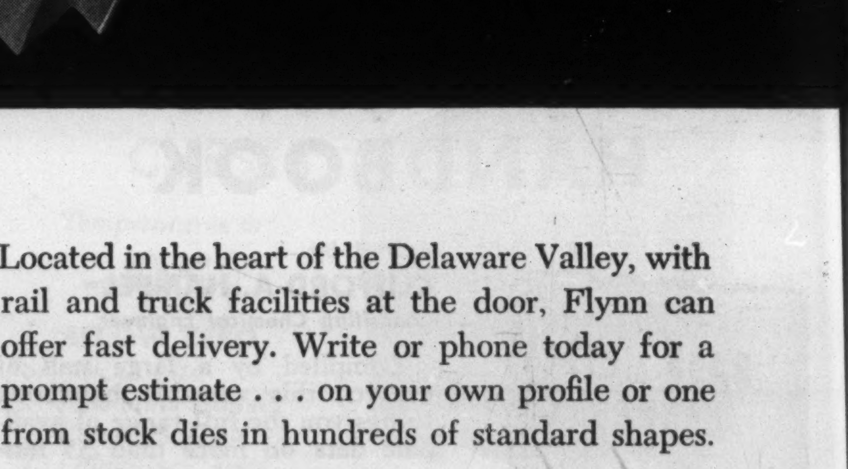
Extrusion Division

Michael FLYNN Manufacturing Co.

700 East Godfrey Avenue, Philadelphia 24, Penna.
Telephone: FIdelity 2-5500

51 East 42nd Street, New York 17, N. Y.
Telephone: MUrray Hill 2-0625

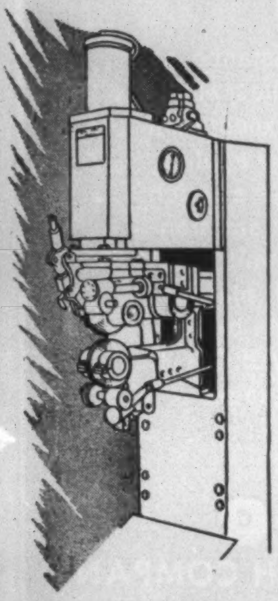
For more information, Circle No. 565



Full details on all six processes!

RESISTANCE WELDING

Theory and Use



Prepared by the
Resistance Welding Committee

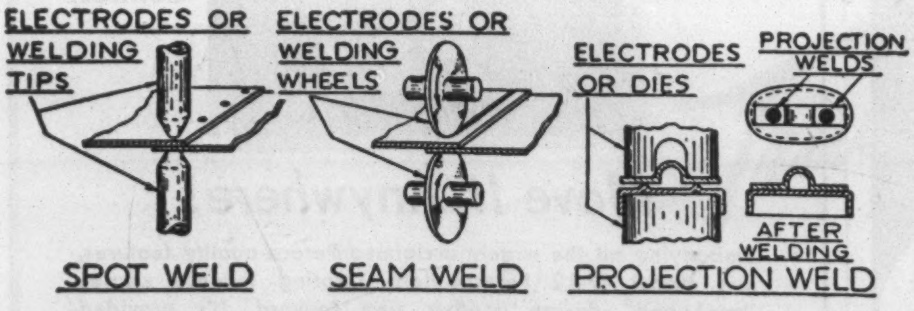
AMERICAN
WELDING
SOCIETY

Here's the one indispensable handbook for everyone interested in welding the thinner gages of all kinds of metals with consistently good results. Every aspect of resistance welding from basic principles to most effective use is presented by outstanding authorities on the subject.

Newest developments such as slope control and the welding of aluminum receive full attention as do such important topics as processes, equipment, precautions, quality control, inspection and testing.

Never before has the entire subject of resistance welding been presented so clearly and simply — in language that can be understood without previous knowledge. Don't fail to order your copy *now!*

6" x 9", 164 pages, $4.50



Mail this coupon for FREE EXAMINATION

REINHOLD PUBLISHING CORPORATION
Dept. M-948, 430 Park Avenue, New York 22, N. Y.

Please rush me a copy of RESISTANCE WELDING for Free Examination. After 10 days, I will send you $4.50 plus shipping charge, or I will return book and owe nothing.

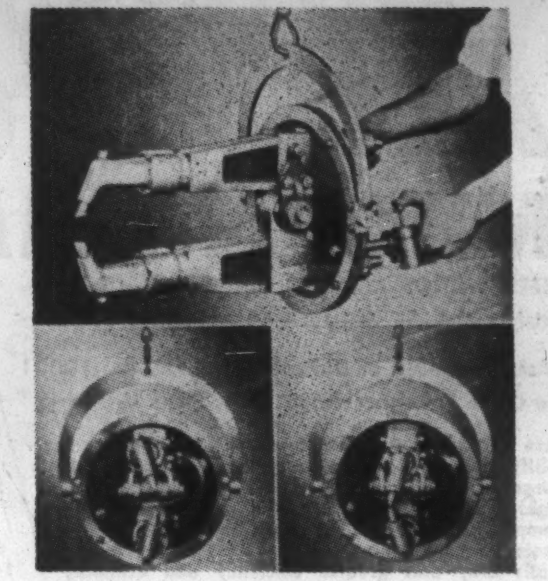
NAME ....

ADDRESS ....

....

CITY AND ZONE ....STATE............

SAVE MONEY: **Enclose $4.50 with order and Reinhold pays all shipping charges. Same return privilege, of course. Please add 3% sales tax on N. Y. C. orders.**



Expert, up-to-the-minute information in these 9 big chapters . . .

1 DEFINITIONS OF RESISTANCE-WELDING TERMS

2 PRINCIPLES OF RESISTANCE WELDING
  - Heating Fundamentals
  - Heat Losses
  - Current Flow
  - Heat Balance

3 RESISTANCE-WELDING PROCESSES
  - Spot Welding
  - Seam Welding
  - Projection Welding
  - Flash Welding
  - Upset Welding
  - Percussion Welding

4 RESISTANCE-WELDING EQUIPMENT
  - Machines
  - Electrical System
  - Controls
  - Electrodes
  - Electrode Care and Maintenance
  - Equipment Calibration

5 WELDING SYMBOLS

6 WELDABILITY OF METALS AND PRECAUTIONS REQUIRED
  - Physical Properties Influencing Weldability
  - Low-Carbon Steels
  - Medium- and High-Carbon and Low-Alloy Steels
  - Stainless Steels
  - Nickel and Nickel-Base Alloys
  - Copper and Copper Alloys
  - Aluminum, Magnesium and Their Alloys
  - Plated and Coated Metals
  - Dissimilar Metals
  - Welding Schedules

7 WELD QUALITY

8 PROCEDURE SPECIFICATIONS AND QUALIFICATION

9 INSPECTION AND TESTING
  - Standard Methods for Testing Resistance Welds
  - AWS Standards and Books

• **For more information, turn to Reader Service Card, Circle No. 525**

For more information, turn to Reader Service Card, Circle No. 522

on the design table
. . . and in the
production line

ACE
NYLON BALLS

KEEP THINGS MOVING SMOOTHLY IN HUNDREDS OF INDUSTRIAL APPLICATIONS!

Mass-Produced of DuPont Nylon FM No. 10001
To Close Tolerances of ±.001. Sizes 1/8" to 3/4"

Ace Nylon Balls have brought new design flexibility and production economy to many of America's largest manufacturers. Uniform, precision-fabricated, light-weight Ace Nylon Balls are tough at low temperatures, stable at high temperatures, and resistant to chemicals and abrasion. Ace Nylon Balls may add greater efficiency and economy to your products, too.

Write for samples, bulletin, price list today

WHY NOT LET OUR ENGINEERS ADVISE YOU?

Complete facilities for fabricating plastic parts for all industries. Estimates submitted promptly on receipt of blueprints or specifications.

ACE PLASTIC COMPANY
Precision Plastic Fabricators and Extruders

ACE HIGH QUALITY

91-48 Van Wyck Expressway • Jamaica 35, N.Y.

SPRAY PAINTING MASKS
A competent engineering staff will counsel with you on the most efficient technique for handling your particular requirements.

CLAMPS AND FIXTURES
Positive pressure and exact registration of the part in the mask. Reduce rejects. Free both hands for productive movements.

CUT FINISHING COSTS THROUGH INCREASED PRODUCTION

PRODUCT DEVELOPMENTS BY

CM

CONFORMING MATRIX

AUTOMATIC MACHINES
Increase production hundreds to one over hand methods. Reduce labor costs. Eliminate need of experienced workmen.

Send for Free Literature Now!

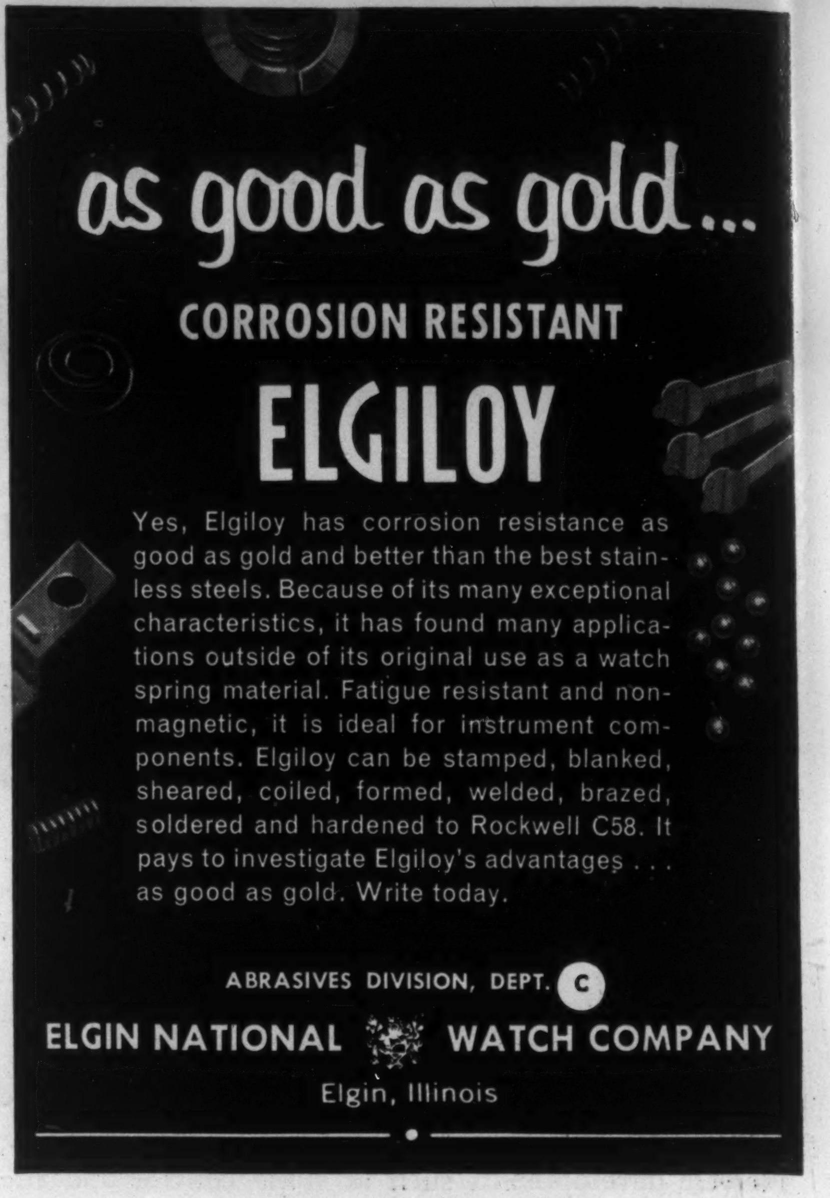
MASK WASHING MACHINES
50% faster than any other make. Cut solvent consumption. Avert production delays due to damaging of masks by hand scrubbing.

See Us At Booth 805 7th NATIONAL PLASTICS EXPOSITION June 11-15

CONFORMING MATRIX CORPORATION
386 Toledo Factories Building **Toledo 2, Ohio**

For more information, turn to Reader Service Card, Circle No. 420

For more information, turn to Reader Service Card, Circle No. 498



as good as gold...

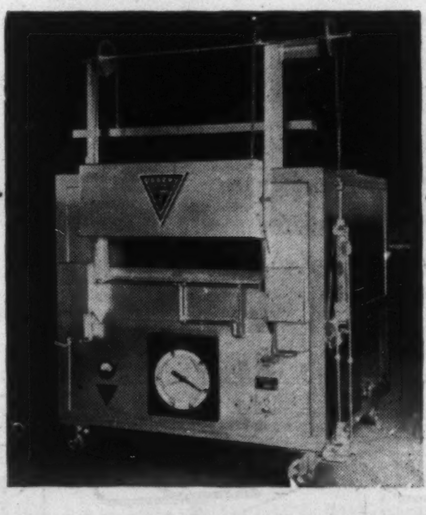
CORROSION RESISTANT

ELGILOY

Yes, Elgiloy has corrosion resistance as good as gold and better than the best stainless steels. Because of its many exceptional characteristics, it has found many applications outside of its original use as a watch spring material. Fatigue resistant and nonmagnetic, it is ideal for instrument components. Elgiloy can be stamped, blanked, sheared, coiled, formed, welded, brazed, soldered and hardened to Rockwell C58. It pays to investigate Elgiloy's advantages . . . as good as gold. Write today.

ABRASIVES DIVISION, DEPT. C

ELGIN NATIONAL WATCH COMPANY
Elgin, Illinois



Completely Packaged

Ready to Connect

Move-It Anywhere!

Embodying all the widely acclaimed Pereco-quality features, this Model TF-12 Pereco Heat Treating Furnace carries "packaged" design another step forward. It's provided with ball bearing casters—permitting it to be easily moved to any location, ready for immediate use upon connection to power source. On the job wherever needed—with an operating temperature of 2200° F. and a 36" w. x 48" d. x 12" h. work chamber. Door is foot controlled, air-lift, with automatically operating flame curtain. For full details of the many features, or variations, of this versatile Furnace write Pereco today.

PERENY EQUIPMENT COMPANY
Dept. A, 893 Chambers Road **Columbus 12, Ohio**

PERECO
Electric Furnaces

PERENY EQUIPMENT COLUMBUS OHIO

For more information, turn to Reader Service Card, Circle No. 431

SCOVILL offers...

EXTRA FAST DELIVERY

(2 to 3 weeks)

of these coiled

ALUMINUM SHEET ALLOYS

1100–(2S)
3003–(3S)
5005–(A50S)
5050–(50S)
3004–(4S)
5052–(52S)

IN GAUGES .006"–.064", INCLUSIVE

SCOVILL *Truspec* **ALUMINUM**

You can **sell** *the difference*

SCOVILL MANUFACTURING COMPANY

Mill Products Division, 99 Mill Street, Waterbury 20, Connecticut. Phone Plaza 4-1171

1116 Great Plain Avenue,
Needham 92, Mass.
Phone Needham 3-3810

Chrysler Building East,
161 East 42nd Street
New York 17, N. Y.
Phone Oxford 7-3222

175 Dodge Street,
Rochester 6, N. Y.
Phone Glenwood 0194

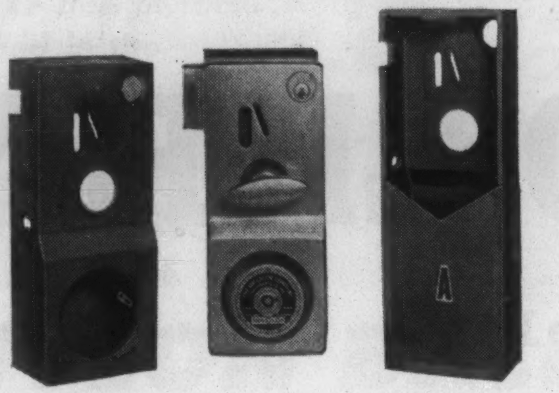
1419 North Broad Street
Philadelphia 22, Penna.
Phone Stevenson 2-5450

16SC56

For more information, turn to Reader Service Card, Circle No. 561

For more information, turn to Reader Service Card, Circle No. 460

OPC PLASTER
These ~~permanent~~ mold castings save time and money



The Nik-O-Lok Co., Indianapolis, eliminated an entire production operation and cut machining time to a bare minimum by using OPC silicon bronze castings for its lock cases. Formerly, the back plate was a separate piece, (A), welded to the case; OPC produces this four-sided casting in a single piece, ready for final finishing and assembly.

Intricately detailed castings, smoothly finished to the most exacting tolerances, are standard at OPC. Our new brochure will give you plenty of ideas for making notable savings on your small parts—write for your copy today.

OPC
OHIO PRECISION CASTINGS, INC.
109 Webb St. • • • • • DAYTON 3, OHIO
Plaster Mold Castings made from
BRASS • BRONZE • ALUMINUM • BERYLLIUM COPPER

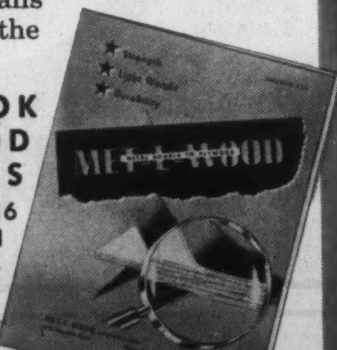
MET-L-WOOD
METAL BONDED TO PLYWOOD

STRUCTURALLY: Like STEEL
WORKABILITY: Like WOOD

● A Met-L-Wood panel ⅜" thick has the same stiffness as a ¼" steel plate—yet weighs only one-third as much! Add to these facts: excellent workability without special tools, inherent sound-deadening, insulating and vibration-damping qualities . . . and smooth, clean surfaces that withstand hard wear, water, and weathering. Isn't there a place for versatile Met-L-Wood in your product planning? Details are yours for the asking in the bulletin described below.

THE ANSWER BOOK ON MET-L-WOOD FOR YOUR USES

Met-L-Wood Bulletin 521 contains 16 pages of technical data, facts and photos to give you a clear, accurate picture of Met-L-Wood characteristics, uses and possibilities. Write for your copy today.



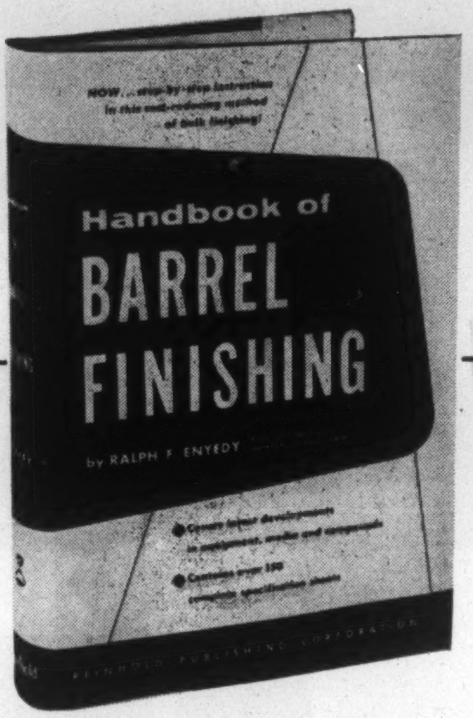
MET-L-WOOD CORPORATION
6755 West 65th Street, Chicago 38, Illinois

For more information, turn to Reader Service Card, Circle No. 485

Complete information on this cost-saving finishing method . . .

Handbook of BARREL FINISHING

by RALPH L. ENYEDY
Industrial Engineer, Electronic Tube Division, Westinghouse Electric Corp., Elmira, N. Y.



1955
288 pages
7" x 10"
$7.50

Here for the first time in book form are the complete details of this precise, economical method of finishing metal and plastic parts!

Every phase of barrel finishing from cleaning and deslugging to coloring, polishing and burnishing is covered in step-by-step sequence. More than 150 complete specification sheets provide all the information necessary for finishing a large variety of parts.

Latest developments in equipment, finishing compounds and methods are described in full detail. Much of the information on such operations as preparation of metals for sealing to glass, deburring of screw machine parts and multibarrel processing has never before appeared in print.

Enyedy's book will prove of utmost interest and value to industrial and methods engineers, finishing department supervisors, suppliers of equipment and raw materials—to anyone concerned with small parts finishing.

Examine This Book 10 Days FREE!
Mail This FREE-TRIAL COUPON

REINHOLD PUBLISHING CORPORATION
Dept. M-950, 430 Park Avenue, New York 22, N. Y.

Rush me a copy of Enyedy's HANDBOOK OF BARREL FINISHING for Free Examination. After 10 days, I will send you $7.50 plus shipping charges, or I will return the book and owe nothing.

NAME ....
ADDRESS ....
CITY & ZONE .... STATE ....

SAVE MONEY: Enclose $7.50 now and we pay all shipping charges. Same return privilege; refund guaranteed.

For more information, turn to Reader Service Card, Circle No. 584

TAM

ZIRCONIUM-MAGNESIUM MASTER ALLOY

INCREASED STRENGTH

AT ELEVATED TEMPERATURES

Light magnesium alloy castings will gain high impact strength at elevated temperatures when Zirconium is added. TAM's Master Alloy provides a most efficient method. Notch bars are readily soluble in production heats. Recoveries are high.

In addition to greater impact strength at elevated temperatures, a tough fine grain structure is produced . . . relatively free of contamination. It is readily castable or extrudable, with minimum microporosity or microshrinkage. It resists corrosion.

Foundrymen prefer TAM Master Alloy for its ease of handling and storing as well as its freedom from obnoxious fuming.

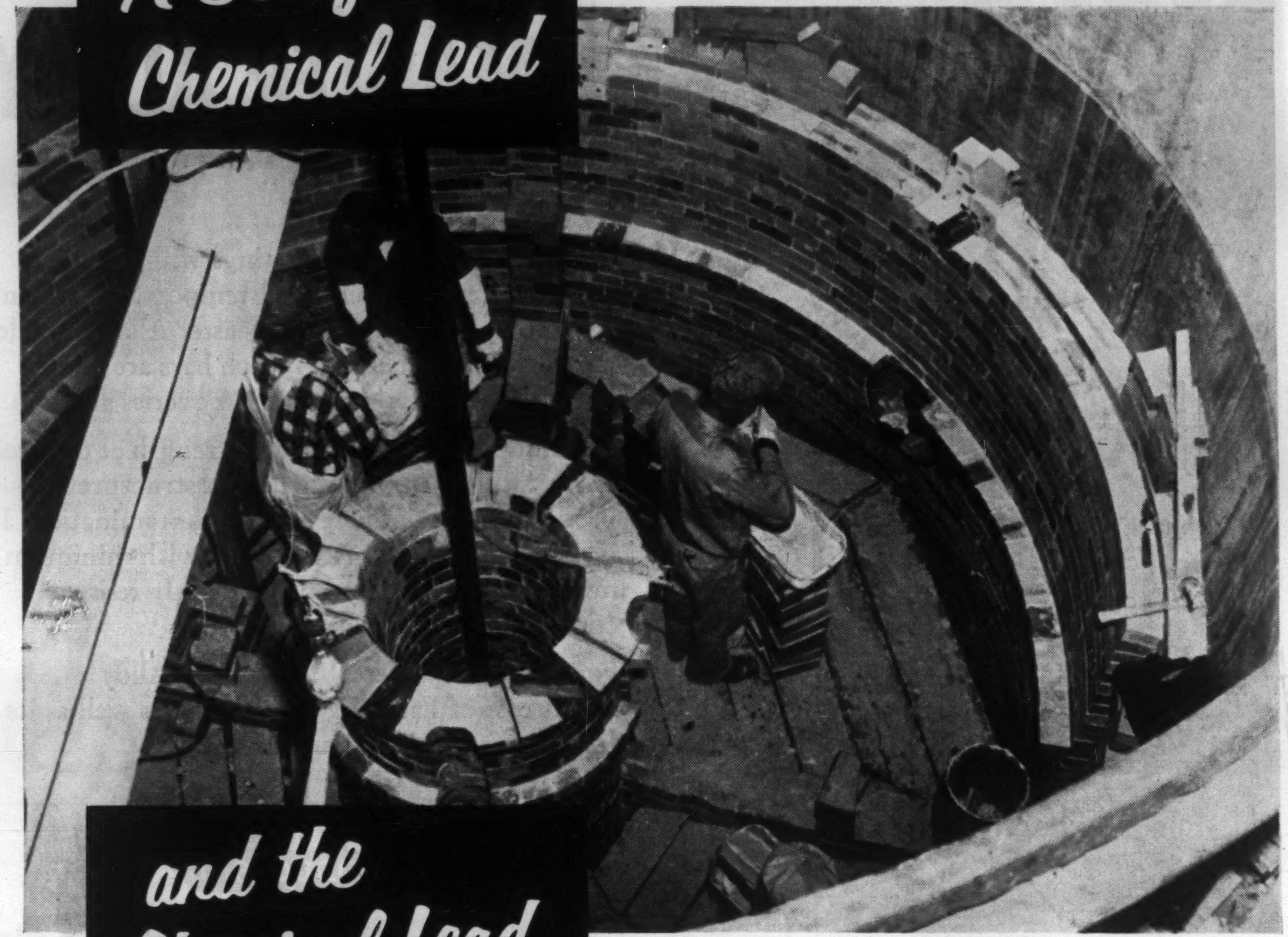
TAM PRODUCTS
Registered U. S. Pat. Off.

TITANIUM ALLOY MFG. DIVISION
NATIONAL LEAD COMPANY
Executive and Sales Offices:
111 Broadway, New York City
General Offices, Works and Research Laboratories:
Niagara Falls, New York

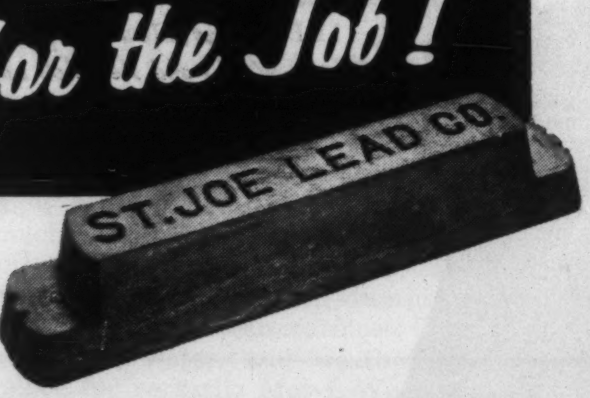
Your order or your inquiry will receive prompt attention when addressed to our New York City office.

For more information, turn to Reader Service Card, Circle No. 533

A Job for Chemical Lead



and the Chemical Lead for the Job!



A method of protecting lead-lined vessels under high temperature conditions is to cover the metal with an inner lining of special acid-resistant brick. The installation shown above is a sulfuric acid concentrator, 16 ft. in diameter and 24 ft, high. Some 19 tons of chemical lead were used in lining the vessel. This type of construction is used commonly in the 450°F range and has been used at higher temperatures. The brick lining provides a temperature gradient to insulate the lead. Since no aggregate material can be entirely impervious to seepage, the corrosives leaking through are stopped by the lead lining and thus prevented from destroying the steel supporting structure. *Photo courtesy Chemsteel Construction Co., Inc.*

TYPICAL ANALYSIS OF ST. JOE CHEMICAL LEAD

Silver	.0100%	Arsenic-Antimony-Tin Combined	.0002%
Copper	.06	Cadmium	.0002
Bismuth	Nil	Cobalt & Nickel	.0046
Zinc	.0001	Lead by difference	99.92+
Iron	.0001		

Among the common metals, lead has no equal in its value to the chemical industry as a construction material for handling and controlling corrosives. The metal's utility in this field is well documented by a wealth of available performance records. The protection afforded by lead is the end-result of an inherent chemical property which is unique with the metal. Exposed to most corrosives, lead automatically forms upon its surface an insoluble, tightly adherent film of salts which henceforth acts as an effective barrier against further corrosion. The uncommon property of the common metal lead to forge its own protective armor is the reason why more than one-third of all the lead consumed annually in this country is used primarily for its resistance to corrosion.

St. Joe Chemical Lead is the most extensively used brand of lead in the chemical industries. Hundreds of thousands of tons are now in use—especially where operating conditions are severe. The metal is an exclusive product derived from the huge ore bodies of southeast Missouri which have been owned and operated by this Company since 1865. Owing to the unusual nature of these ores, there is present in the lead smelted from them a combination of copper and small amounts of other elements which produces a grade of lead particularly immune to the attack of most corrosives. At the same time, this natural chemical lead has a lower creep rate and a higher resistance to fatigue failure than lead produced from any other ores.

ST. JOSEPH LEAD COMPANY
250 PARK AVENUE, NEW YORK 17, NEW YORK
THE LARGEST PRODUCER OF LEAD
IN THE UNITED STATES

High strength, low cost...

C-D-F paper-base Dilecto®

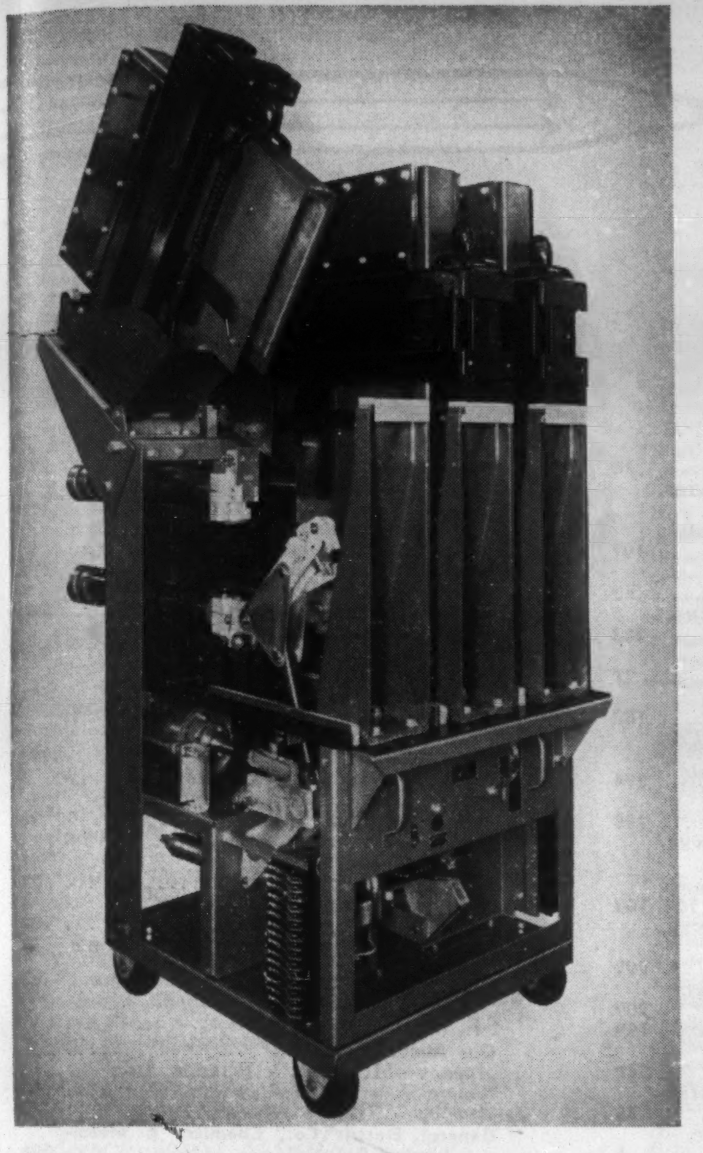
Excellent electrical properties, ease of machining and punching, with low costs are features of the many paper-base grades of Dilecto laminated plastics. Adaptable to forming, Dilecto is a mechanically versatile insulating material that withstands difficult operating conditions, moisture and temperature variations.

Insulating papers include kraft-alpha, cotton rag, and asbestos. Improved phenolic, or melamine silicone laminating resins are used. C-D-F builds flame resistance into a paper-base laminate—you get a worthwhile, easier-to-machine substitute for a glass-base laminate. C-D-F bonds copper uniformly to Dilecto — you get a superior metal-clad laminate for printed circuit applications.

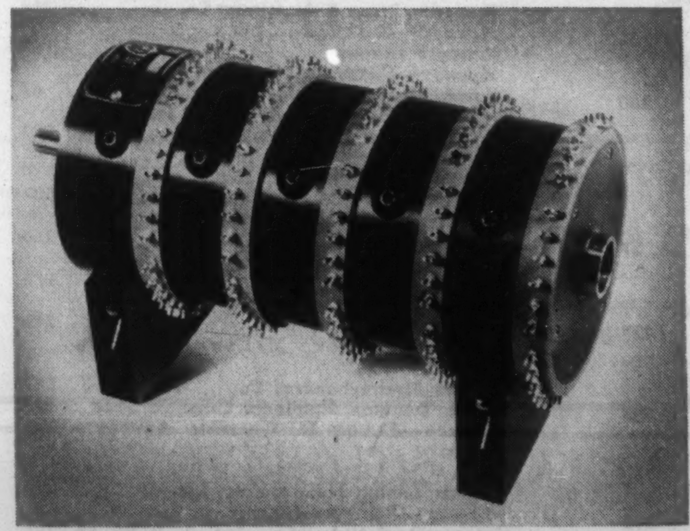
A big, reliable source of supply, C-D-F helps you improve design, simplify purchasing, speed production. Look in C-D-F's catalog in the Product Design File (Sweet's) for the address of your nearest C-D-F sales engineer. Write for samples and new Dilecto catalog:

CONTINENTAL DIAMOND FIBRE

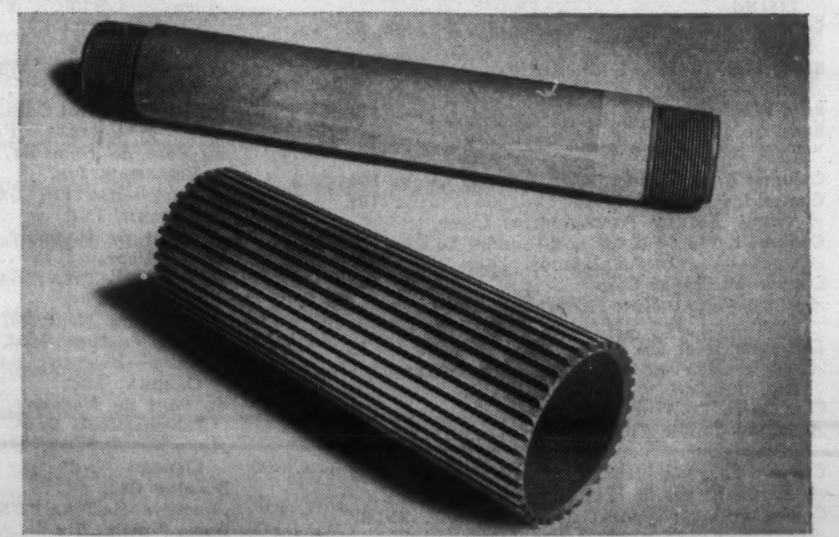
CONTINENTAL-DIAMOND FIBRE DIVISION OF THE BUDD COMPANY, INC.
NEWARK 25, DELAWARE



ROLLED AND MOLDED ARC CHUTE SHELLS, made by C-D-F for the I-T-E Circuit Breaker Company for 7.5 and 15 KV air magnetic circuit breaker, are good examples of paper-base Dilecto doing a hard job. Each completely closed insulating shell (NEMA grade X) has flame-retardant construction, negligible water absorption, and high dielectric strength at all points to withstand impulse test requirements.



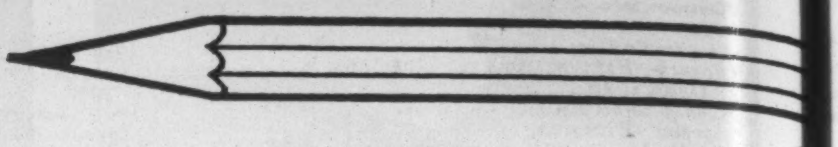
THIS HIGH-SPEED SAMPLING SWITCH, for missile telemetering and automation applications has a paper-base Dilecto tubing body. Materials engineers at General Devices, Inc., selected Dilecto "for its mechanical properties and low moisture absorption."



ACCURATE MACHINING, SMOOTH FINISHING are two merits of paper-base Dilecto. Note the perfection of milling cuts and threads! C-D-F has mass-production equipment, or can furnish sheets, tubes and rods with cost-cutting machining information.

For more information, turn to Reader Service Card, Circle No. 430

Advertisers & their Agencies



Use this index for the latest information on how and where to use **materials, parts and finishes** . . . because more companies advertise these products in Materials & Methods than in any other magazine.

Ace Plastic Co. 292
Agency—Harold Marshall Advertising Co., Inc.
Acushnet Process Co. 174
Agency—Rossi & Hirshson
Allegheny Ludlum Steel Corp. 285
Agency—W. S. Walker Advertising, Inc.
Allied Research Products, Inc. 261
Agency—Emery Advertising Corp.
Alloy Metal Wire Div. 197
Agency—W. L. Towne Advertising
Alpha Molykote Corp. 288
Agency—George F. Walsh Advertising Agency
Aluminum Company of America 89, 90, 91, 92, 258
Agency—Fuller & Smith & Ross, Inc.
American Agile Corp. 254
Agency—Dix & Eaton
American Brake Shoe Co. 164
American Brass Co. 2nd Cover
Agency—Kenyon & Eckhardt, Inc.
American Chain & Cable Co., Inc. 170
American Felt Co. 30
Agency—St. Georges & Keyes, Inc.
American Hard Rubber Co. 7
Agency—W. L. Towne Advertising
American Machine & Foundry Co. 65
American Machine & Metals, Inc. 8
American Plastics Corp. 109
Agency—Heffernan & McMahon, Inc.
American Smelting & Refining Co., Continuous-Cast Products Dept. 79
Agency—John Mather Lupton Co., Inc.
Ampco Metal, Inc. 80
Agency—Hoffman & York, Inc.
Anchor Plastics Co., Inc. 200
Agency—Richard & Gunther, Inc.
Armco Steel Corp. 45
Agency—N. W. Ayer & Son, Inc.
Armstrong Cork Co., Industrial Div. 50
Agency—Batten, Barton, Durstine & Osborn, Inc.
Arwood Precision Casting Corp. 218
Agency—Richard & Gunther, Inc.

Baldwin-Lima-Hamilton Corp. 173
Agency—Ketchum, MacLeod & Grove, Inc.
Bakelite Co. 201
Agency—J. M. Mathes, Inc.
Bausch & Lomb Optical Co. 226, 278
Agency—Ed Wolff & Associates
Bead Chain Mfg. Co. 286
Agency—Kelly, Nason, Inc.
Bean, Morris, & Co. 188
Agency—Odiorne Industrial Advertising
Bethlehem Steel Co. 48, 54
Agency—Jones & Brakeley, Inc.
Black Light Corp. of America 287
Agency—Edward S. Kellogg Co.
Borg-Warner Corp. 221
Budd Co., Inc. 299

Calumet & Hecla, Inc. 191
Cambridge Wire Cloth Co. 186
Agency—Emery Advertising Corp.
Campbell, Wyant & Cannon Foundry Co. 179
Agency—Waldie & Briggs, Inc.
Cannon-Muskegon Corp. 244
Agency—Klau-Van Pietersom-Dunlap, Inc.
Carpenter Steel Co. 35
Agency—Beaumont, Heller & Sperling, Inc.
Cast Optics Corp. 287
Agency—Town Advertising Associates ates
Ceilcote Co., Inc. 282
Agency—Penn & Hamaker, Inc.
Celanese Corp. of America 86, 87
Agency—Ellington & Co., Inc.
Chace, W. M. Co. 250
Agency—Bingham Technical Advertising
Champion Rivet Co. 276
Agency—Crier Advertising Service
Chase Brass & Copper Co., Inc. 108
Agency—Cunningham & Walsh, Inc.
Chemical Corp. 258
Agency—William B. Remington, Inc.
Chicago Rawhide Manufacturing Co. 70
Agency—Wesley Aves & Associates, Inc.
Cincinnati Milling Machine Co., Hydrospin Div. 101
Agency—Keelor & Stites Co.
Cleveland Welding Co. 65
Agency—Fletcher D. Richards, Inc.
Climax Molybdenum Co. 233
Agency—G. M. Basford Co.
Coated Coil Corp. 26, 27
Agency—Robert B. Grady Co.
Cold Metal Products Co. 182
Agency—H. M. Klingensmith Co., Inc.
Colonial Plastics Mfg. Co., Industrial Div. 284
Agency—Bayless-Kerr Co.
Commercial Plastics & Supply Corp. 288
Agency—Walter J. Gallagher Advertising
Commonwealth of Puerto Rico, Economic Development Administration 102, 103
Agency—Ogilvy, Benson & Mather, Inc.
Conforming Matrix Corp. 292
Agency—Wendt Advertising Agency
Consolidated Molded Products Corp. 209
Continental-Diamond Fibre Div. 299
Agency—Geare-Marston
Continental Rubber Works, Inc. 248
Agency—Eugene C. Laird Advertising
Cooper Alloy Corp. 275
Agency—Mahool Advertising, Inc.
Copperweld Steel Co. 6
Agency—Bayless-Kerr Co.
Corning Glass Works 51
Agency—Charles L. Rumrill & Co., Inc.
Crane Packing Co. 220
Agency—Symonds, MacKenzie & Co., Inc.
Crucible Steel Company of America 64, 175, 185, 205, 211, 213, 225, 241
Agency—G. M. Basford Co.
Crystal-X Corp. 268
Agency—Jessup Associates

Detrex Corp. 246
Agency—Gray & Kilgore, Inc.
Diversey Corp. 234
Agency—Proebstring-Taylor, Inc.
Dixon Corp. 289
Agency—George T. Metcalf Co.
Dollin Corp. 286
Agency—Thoma & Gill
Dow Chemical Co. 28, 29
Agency—MacManus, John & Adams, Inc.
Dow Corning Corp. 159, 160
Agency—Church & Guisewite Advertising, Inc.
Driver-Harris Co. 181
Agency—Lewin, Williams & Saylor, Inc.
Du-Lite Chemical Corp. 260
Agency—Charles Palm & Co.
du Pont de Nemours, E. I., & Co., Inc., Elastomers Div. 3rd Cover
Agency—Batten, Barton, Durstine & Osborn, Inc.
du Pont de Nemours, E. I., & Co., Inc., Film Dept. 36, 37
Agency—Batten, Barton, Durstine & Osborn, Inc.
du Pont de Nemours, E. I., & Co., Inc. Photo Products Dept. 227
Agency—Batten, Barton, Durstine & Osborn, Inc.
du Pont de Nemours, E. I., & Co., Inc., Polychemicals Dept. 33, 34
Agency—Batten, Barton, Durstine & Osborn, Inc.
Duraloy Co. 180
Agency—Sanger-Funnell, Inc.
Durez Plastics Div. 242
Agency—Comstock & Co.

Eastman Chemical Products, Inc. 189
Agency—Fred Wittner Advertising
Electric Furnace Co. 274
Agency—Henry T. Bourne Advertising Agency, Inc.
Electro-Alloys Div. 164
Agency—Fuller & Smith & Ross, Inc.
Elgin National Watch Co. 292
Agency—Waldie & Briggs, Inc.
Enjay Co., Inc. 162
Agency—McCann-Erickson, Inc.

Fabricon Products, Inc. 178
Agency—E. C. Watkins & Co.
Fansteel Metallurgical Corp. 240
Agency—Symonds, MacKenzie & Co.
Felters Co. 238
Agency—Sutherland-Abbott
Firestone Plastics Co. 183
Agency—Grey Advertising Agency, Inc.
Flynn, Michael, Mfg. Co. 290
Agency—William Jenkins Advertising, Inc.
Formed Steel Tube Institute 98, 99
Agency—Downing Industrial Advertising, Inc.
Formica Co. 22
Agency—Perry-Brown, Inc.
Frasse, Peter A., & Co., Inc. 107
Agency—Picard, Marvin & Redfield, Inc.
Frenchtown Porcelain Co. 288
Agency—Michener Co.

Gas Atmospheres, Inc. 236
Agency—McClure & Wilder, Inc.
General American Transportation Corp. 199
Agency—Weiss & Geller, Inc.
General Electric Co., Chemical & Metallurgical Div. 206
Agency—Benton & Bowles, Inc.
General Mills, Inc. 62, 63
Agency—Knox Reeves Advertising, Inc.
General Plate Div. 279
Agency—Sutherland-Abbott
Georgia-Pacific Plywood Co. 289
Agency—Fuller & Smith & Ross, Inc.
Gering Products, Inc. 212
Agency—Lewin, Williams & Saylor, Inc.
Glidden Co., Industrial Finishes Div. 16
Agency—Meldrum & Fewsmith, Inc.
Goodrich, B. F., Chemical Co. 5
Agency—Griswold-Eshleman Co.
Goodyear Tire & Rubber Co. 52, 53
Agency—Kudner Agency, Inc.
Gordon, Claud S., Co. 264
Agency—Merrill, McEnroe & Associates, Inc.
Great American Industries, Inc. 88
Great Lakes Steel Corp. 166
Agency—Campbell-Ewald Co.
Gumm, Frederick, Chemical Co., Inc. 274
Agency—Sanger-Funnell, Inc.

Hampden Brass & Aluminum Co. 268
Agency—Black & Musen
Handy & Harman 187
Agency—Peterson & Kempner, Inc.
Harnischfeger Corp. 67
Agency—Hoffman & York, Inc.
Harshaw Chemical Co. 229
Hartwell, H. N., & Son, Inc. 60, 61
Agency—Sackel Co., Inc.
Haynes Stellite Co. 257
Agency—J. M. Mathes, Inc.
Hays Mfg. Co. 266
Agency—John Harder Fenstermacher
Hevi Duty Electric Co. 176
Agency—Camm, Costigan, Inc.
Hitchiner Mfg. Co., Inc. 216
Agency—J. Roy McLennan Advertising
Hooker Electrochemical Co. 242
Hunter Douglas Aluminum Corp. 223
Agency—Clyde D. Graham Advertising

Illinois Testing Laboratories, Inc. 228
Agency—Buchen Co.
International Nickel Co., Inc. 2, 38, 56, 281
Agency—Marschalk and Pratt, Div., McCann-Erickson, Inc.
Isocyanate Products, Inc. 270
Agency—Gauge Associates

Kaiser Aluminum & Chemical Corp. 31, 32
Agency—Young & Rubicam, Inc.
Kawneer Co. 208
Agency—Fuller & Smith & Ross, Inc.

Kellogg, M. W., Co. 255
Agency—Ellington & Co., Inc.
Kendall Co. 265
Agency—Leo Burnett Co., Inc.
Keystone Steel & Wire Co. 224
Agency—Thomson Advertising, Inc.
Koppers Co., Inc. 20, 215
Agency—Batten, Barton, Durstine & Osborn, Inc.
Kuhn & Jacob Molding & Tool Co. 260
Agency—Eldridge, Inc.
Kux Machine Co. 247
Agency—Kuttner & Kuttner, Inc.

Lebanon Steel Foundry 204
Agency—Howard E. Marshall Advertising
Lindberg Engineering Co. 104, 105
Agency—Don Colvin & Co., Inc.
Linde Air Products Co. 100
Agency—J. M. Mathes, Inc.
Lindsay Chemical Co. 49
Agency—C. Franklin Brown, Inc.
L•O•F Glass Fibers Co. 253
Agency—Brooke, Smith, French & Dorrance, Inc.
Lord Chemical Corp. 172
Agency—Adams Associates, Inc.
Lukens Steel Co. 245
Agency—J. M. Mathes, Inc.

Makepeace, D. E., Co. 286
Agency—Picard, Marvin & Redfield
Mallory, P. R., & Co., Inc. 10
Agency—Aitkin-Kynett Co.
Mallory-Sharon Titanium Corp. 259
Agency—Griswold-Eshleman Co.
Marbon Chemical Div. 221
Agency—Oscar Holtzman Advertising
McDanel Refractory Porcelain Co. 254
Agency—Meek & Thomas, Inc.
McLouth Steel Corp. 84
Agency—Denman & Baker, Inc.
Metal & Thermit Corp. 237
Agency—Marsteller, Rickard, Gebhardt & Reed, Inc.
Metallizing Engineering Co., Inc. 202, 203
Agency—Schuyler Hopper Co.
Metals & Controls Corp. 279
Met-L-Wood Corp. 294
Agency—Armstrong Advertising Agency
Midland Industrial Finishes Co. 284
Agency—Western Advertising Agency
Midwest Molding & Mfg. Co. 280
Agency—Robert A. Gallagher Advertising
Minnesota Mining & Mfg. Co. 81
Agency—MacManus, John & Adams, Inc.
Mobay Chemical Co. 85
Agency—Smith, Taylor & Jenkins, Inc.
Molded Fiber Glass Co. 272
Agency—Carpenter Advertising Co.
Monsanto Chemical Co., Plastics Div. ...96, 97
Agency—Needham, Louis & Brorby, Inc.
Monsanto Chemical Co., Organic Chemicals Div. 24
Agency—Gardner Advertising Co.
Mt. Vernon Die Casting Corp. 239
Agency—Lewin, Williams & Saylor, Inc.
Mueller Brass Co. 82, 83
Agency—Price, Tanner & Willox, Inc.

National Lead Co. 295
National Research Corp. 211
National Steel Corp. 166
New Jersey Zinc Co. 14
Niagara Blower Co. 272
Agency—Moss-Chase Co.
Nopco Chemical Co. 18
Agency—Lewin, Williams & Saylor, Inc.
Northwest Chemical Co. 177
Agency—F. B. Hubert Advertising Counselors
Norton Co. 39
Agency—James Thomas Chirurg Co.

Ohio Carbon Co. 200
Agency—Herb W. Buerger Advertising
Ohio Crankshaft Co. 171
Agency—Carr Liggett Advertising Inc.
Ohio Precision Castings, Inc. 294
Agency—Industrial Advertising Service

Penn Precision Products, Inc. 266
Agency—Beaumont, Heller & Sperling, Inc.
Pereny Equipment Co. 292
Agency—Wheeler, Kight & Gainey, Inc
Phoenix Products Co. 256
Agency—Barnes Advertising Agency, Inc.
Picker X-Ray Corp. 235
Polyken Products Dept. 265
Agency—Leo Burnett Co., Inc.
Porter, H. K. Co., Inc. 197
Powdered Metal Products Div. 271
Precision Extrusions 210
Agency—Roy F. Cratty Agency
Pressed Steel Tank Co. 214
Agency—Buchen Co.

Ransburg Electro-Coating Corp. 192
Agency—H. L. Ross Advertising
Reichhold Chemicals, Inc. 15
Agency—MacManus, John & Adams, Inc.
Reinhold Publishing Corp. 222, 270, 289, 291, 294
Rem-Cru Titanium, Inc. 241
Agency—G. M. Basford Co.
Republic Steel Corp. 42, 43
Agency—Meldrum & Fewsmith, Inc.
Resistoflex Corp. 232
Agency—Marsteller, Rickard, Gebhardt & Reed, Inc.
Revco, Inc. 288
Agency—Fuller & Smith & Ross, Inc.
Revere Copper & Brass, Inc. 243
Agency—St. Georges & Keyes, Inc.
Reynolds Metals Co. 40, 41, 106
Agency—Clinton E. Frank, Inc.
Richardson Co. 283
Agency—Fensholt Advertising Agency, Inc.
Riehle Testing Machines Div. 8
Agency—L. W. Ramsey Advertising Agency
Rogers Corp. 219
Agency—Charles Brunelle Co.
Rogers, Dayton Manufacturing Co. 289
Agency—Keystone Advertising, Inc.
Rolle Mfg. Co. 198
Agency—Harry P. Bridge Co.
Rubatex Div. 88
Agency—Houck & Co., Inc.
Ryerson, Joseph T., & Sons, Inc. 110
Agency—Calkins & Holden, Inc.

St. Joseph Lead Co. 296
Agency—Walter Taegen Associates
Scott Testers, Inc. 256
Agency—Richard Thorndike Agency
Scovill Manufacturing Co. 293
Agency—Edward W. Robotham Co.
Seiberling Rubber Co. 231
Agency—Meldrum & Fewsmith, Inc.
Sharon Steel Corp. 168
Agency—McClure & Wilder, Inc.
Silicones Div. 196
Agency—J. M. Mathes, Inc.
Sivyer Steel Casting Co. 94, 95
Agency—Hoffman & York, Inc.
South Florida Test Service 252
Spaulding Fibre Co., Inc. 57
Agency—Landsheft & Barber, Inc.
Spencer Turbine Co. 66
Agency—W. L. Towne
Standard Tube Co. 273
Agency—Zimmer, Keller & Calvert, Inc.
Star Porcelain Co. 69
Agency—Michener Co.
Stokes, F. J., Machine Co. 262, 263
Agency—Aitkin-Kynett Co.
Sylvania Electric Products, Inc., Parts Div. 217
Agency—J. Walter Thompson Co.
Sylvania Electric Products, Inc., Tungsten & Chemical Div. 251
Agency—J. Walter Thompson Co.
Synthane Corp. 249
Agency—Arndt, Preston, Chapin, Lamb & Keen, Inc.

Taylor Fibre Co. 93
Agency—Aitkin-Kynett Co.
Technic, Inc. 286
Agency—George T. Metcalf Co.
Thermo Electric Co., Inc. 287
Agency—Fred Lange Associates, Inc.
Thomas Strip Div. 193, 194, 195
Agency—Bond & Starr, Inc.
Tickle, Arthur, Engineering Works 287
Agency—Ritter, Sanford & Price, Inc.
Timken Roller Bearing Co., Steel & Tube Div. ....Back Cover
Agency—Batten, Barton, Durstine & Osborn, Inc.
Titanium Alloy Mfg. Div. 295
Agency—Comstock & Co.
Torrington Co. 267
Agency—Hazard Advertising Co., Inc.
Trent Tube Co. 64
Agency—G. M. Basford Co.

Union Carbide & Carbon Corp. 100, 196, 201, 257
United States Graphite Co. 46, 47, 55
Agency—Price, Tanner & Willox, Inc.
United States Gypsum Co. 58, 59
Agency—Fulton, Morrissey Co.
United States Stoneware Co. 44
Agency—Ralph Gross Advertising, Inc.
United Wire & Supply Corp. 190
Agency—Creamer-Trowbridge Co.

Vacuum Metals Corp. 211
Agency—G. M. Basford Co.
Van Dorn Iron Works Co. 284

Western Felt Works 252
Agency—Critchfield & Co.
Westinghouse, Bettis Plant 264
Agency—Ketchum, MacLeod & Grove, Inc.
Westlake Plastics Co. 268
Agency—Jessup Associates
Whistler, S. B., & Sons, Inc. 282
Agency—Comstock & Co.
Whitehead Metal Products Co. 269
Agency—Sanger-Funnell, Inc.
Wilson Mechanical Instrument Div. 170
Agency—Reincke, Meyer & Finn, Inc.
Wolverine Tube Div. 191
Agency—Gray & Kilgore, Inc.
W W Alloys, Inc., Div. of Fansteel Metallurgical Corp. 184
Agency—Bingham Technical Advertising
Wyckoff Steel Co. 230
Agency—Downing Industrial Advertising, Inc.
Wyman-Gordon Co. 277
Agency—John W. Odlin Co., Inc. .. ....

Yale & Towne Mfg. Co. 271
Agency—Ruthrauff & Ryan, Inc.
Youngstown Sheet and Tube Co. 68
Agency—Griswold-Eshleman Co.

advertising sales staff

Materials & Methods, 430 Park Avenue, New York 22, New York • MUrray Hill 8-8600

M. RANDOLPH LONG *Advertising Sales Manager*

NEW YORK OFFICE:
A. STEWART HALE *District Manager*
GEORGE L. FOX, JR. *District Manager*
BEVIN SMITH *District Manager*

CHICAGO OFFICE:
111 W. Washington St., Chicago 2. RAndolph 6-8497
A. E. FOUNTAIN *District Manager*
PHILIP O'KEEFE *District Manager*

CLEVELAND OFFICE:
815 Superior Ave., N.E., Cleveland 14. Prospect 1-5583
H. CHARLES ESGAR *District Manager*
D. W. HUETTNER *District Manager*

SAN FRANCISCO OFFICE:
625 Market Street, San Francisco 5. Yukon 6-0647
ROY M. McDONALD *District Manager*

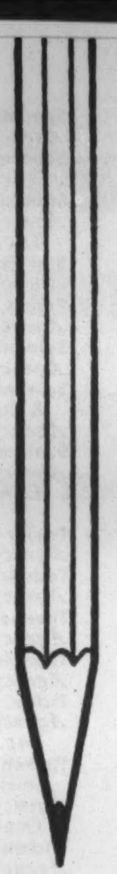
LOS ANGELES OFFICE:
3727 West 6th St., Los Angeles 5. Dunkirk 7-5391
C. J. GRABB, JR. *District Manager*

SEATTLE OFFICE:
1008 Western Ave., Seattle 4. Elliott 3767
HARRY ABNEY *District Manager*

DALLAS OFFICE:
5526 Dyer Street, Dallas 6. FOrest 8-5510
ED J. WHETZLE *District Manager*

HOUSTON OFFICE:
3217 Montrose Blvd., Houston 6. Jackson 9-6711
FRANK N. VICKREY *District Manager*

DENVER OFFICE:
222 Colorado National Bank Bldg., Denver 2.
Keystone 4-4669
ROBERT H. HEIDERSBACH *District Manager*



the last word

A Successful Beginning

I am happy to report that the first Design Engineering Show—both the technical conference and the exposition—was a success far beyond everyone's expectations. I, for one, predicted that the attendance at the conference would run between 400 and 500. Actual attendance was well over 1200. And over 11,000 viewed the exhibits set up in Philadelphia's Convention Hall.

In addition to quantity, there was quality. Most of the sessions held a full audience to the end, and informal discussions with the authors continued on the platform long after the meetings were adjourned. Another indication of the quality of the affair was the caliber of personnel manning the exposition booths. They were by and large technical men who knew their products and could answer directly the questions put to them by the engineers and designers attending the show.

There is no doubt in my mind that the Design Engineering Show and Conference will continue to grow and that it will do a great deal to unify and strengthen the design engineering profession.

Come See Us

When you attend the Plastics Show this month in New York (see p 17), be sure to pay us a visit at our booth (No. 437). The picture gives you an example of what you'll see. I don't want to mislead you, though. The blonde will not be there, but the plastics pressure vessel at which she is smiling will be. You will also see on display samples of other materials and products we have been talking about in M&M articles recently—foam plastics; rigid heat resistant polyethylenes; new thermoplastic sheet materials; and various coatings and finishes for plastics.

Moonlight and No Plastics

Speaking of the Plastics Show, the Society of the Plastics Industry has planned a moonlight cruise. "Will it be a plastics boat?" you may ask. Well, here is the description of the boat taken verbatim from the SPI folder: "The Liberty Belle has been issued the . . . highest classification certificate. She's of *all-steel construction* (italics ours) with 82 water-tight compartments."

H. R. Clauser

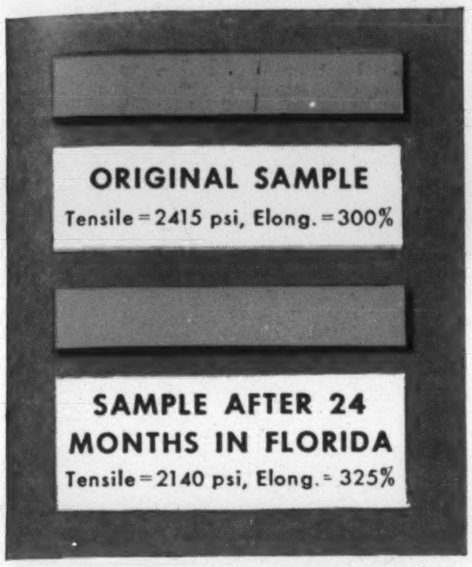
Editor

using

DU PONT ELASTOMERS

NEOPRENE • HYPALON®

4 in Design


ORIGINAL SAMPLE
Tensile = 2415 psi, Elong. = 300%
SAMPLE AFTER 24 MONTHS IN FLORIDA
Tensile = 2140 psi, Elong. = 325%

HYPALON® can be compounded in an unlimited range of weather-resistant colors

Hypalon, Du Pont's new synthetic rubber, brings brilliant and varied colors as well as superior performance to the design field. Colored compounds of Hypalon start bright . . . *stay* bright despite severe exposure conditions indoors or outdoors. The samples shown above, for example, were subjected to two years of outdoor exposure. There is virtually no change in color and negligible change in physical properties.

In addition to outstanding color stability, Hypalon has many other advantages that can help your products give *extra-long service* on industry's toughest jobs. Compared to other kinds of rubber, Hypalon shows unusual resistance to hardening at elevated temperatures (250° to 350° F.). It is completely resistant to ozone and has exceptional resistance to strong oxidizing agents.

When your design calls for a resilient material that must have exceptional resistance to these conditions, it will pay you to take a close look at Hypalon.

NEOPRENE air-brake tube still in service after 5,500,000 flexings

No downtime in 4 years

The brake element shown is part of a clutch-and-brake unit which is capable of stopping heavy rotating equipment within 1/10 of a second. One such unit has piled up a record of 5,500,000 engagements in four years *without any maintenance*. The key to this kind of performance lies in the design of the machine and in the use of two rayon-reinforced neoprene tubes.

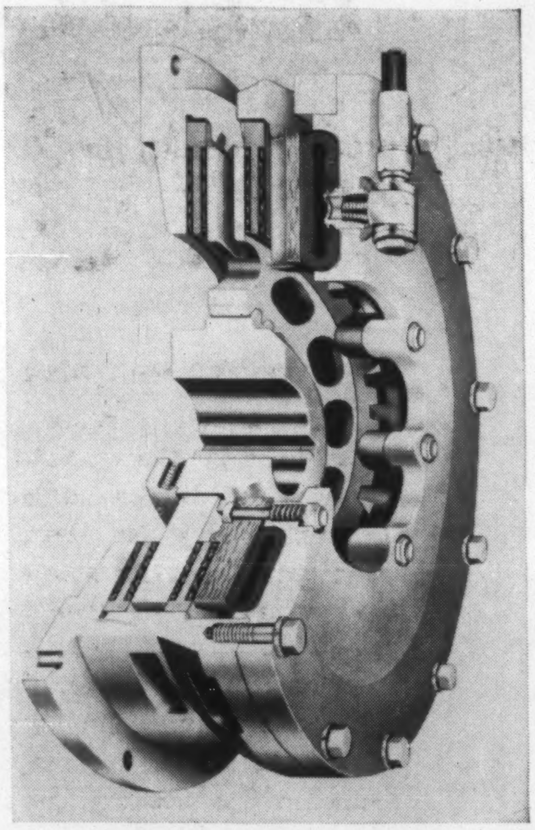
Typically, two of the pictured elements are used together, one serving as the clutch, the other as the brake. When the stop switch is thrown, compressed air is released from the neoprene tube in the clutch element; this disengages friction plates in the clutch and disconnects the drive motor from the driven machine. At the same time, in the brake element, compressed air is admitted to the neoprene tube, engaging friction plates and halting the machine.

Neoprene resists oil, high temperatures

Neoprene's superior oil resistance and durability at high temperatures have made the performance of this clutch and brake possible. Natural rubber tubes previously used were deteriorated by heat and by the oil that almost invariably gets into any compressed-air supply. They swelled, and the inside surfaces tended to become tacky and stick together. When rayon-reinforced neoprene air tubes were used, the problem was solved.

Neoprene makes a better design

In designing new products or improving old ones, neoprene stands up where ordinary resilient materials fail. Neoprene offers the designer resistance to oil, heat, weathering, chemicals and abrasion. It improves product performance—cuts maintenance costs. Complete property data and typical neoprene application data are available.



SECTIONAL VIEW of brake element, with Neoprene air tube in red

DU PONT
REG. U. S. PAT. OFF.

HYPALON *is a registered trademark of E. I. du Pont de Nemours & Co. (Inc.)*

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

Please send further information and add my name to the mailing list for your free publications, the "Neoprene Notebook" and "Facts about HYPALON®," which show how the Du Pont elastomers are used in designing new products, improving old. I am particularly interested in ______________________

E. I. du Pont de Nemours & Co. (Inc.)
Elastomers Division, Dept. MM-6
Wilmington 98, Delaware

Name ______________________ **Position** ____________
Firm ______________________
Address ______________________
City ______________________ **State** ____________

How to make your automatic heat-treating and hardening even more automatic

...at no extra cost

FAST, continuous operation is the key to profitable automatic forging production lines. Especially in high speed heat-treating and hardening operations. They're extremely sensitive to changes in chemical composition and structure of steel used. Interruptions to make tests or adjustments slow production, increase costs, reduce the advantages of automatic operation. This makes the uniformity of the steel you use an even more vital factor. The more uniform the steel, the steadier the production and the greater the potential you can realize from your automatic equipment.

You can get the utmost in uniformity, and automatic operation—at no extra cost—by using Timken® fine alloy steel. Uniformity is constant from bar to bar, heat to heat, order to order.

We take many extra quality-control steps to assure this uniformity. For example, the Timken Company uses a magnetic stirrer for molten steel to assure equal distribution of alloys, uniform temperature and improved working of the slag. It's the first installation of its type in the United States.

To further assure uniformity, your order of Timken fine alloy steel is handled individually. We target our conditioning procedures to meet your end use requirements. Each bar is stamped to identify the heat it came from. This limits variations within an order as well as from order to order. And every heat is examined spectrometrically to insure uniform grain size.

To make your automatic heat-treating and hardening operations even *more* automatic—at no extra cost—always specify Timken fine alloy steel. You'll get money-saving performance and uniform results every time. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

5350

TIMKEN *Fine Alloy* **STEEL**

TRADE-MARK REG. U. S. PAT. OFF.

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS STEEL TUBING

For more information, turn to Reader Service Card, Circle No. 539